4.0 RESULTS OF THE TRACK 2 INVESTIGATION AND RISK ASSESSMENT

This section summarizes the results from the five sites within OU 3-07 that underwent a Track 2 investigation and assesses the risk to human health according to the methodology described in Section 3. The sites included in this section are CPP-26, CPP-28, CPP-31, CPP-32E, and CPP-79. In addition, the perched ground water associated with well 55-06 was also investigated and will be evaluated separately in Section 5 of this report.

The organization of this section is on a "per site" basis. This means that a complete description for each site is provided that includes a discussion of the site background (if necessary), the nature and extent of contamination, the quantification of exposure, the risk characterization, the uncertainty, and the human health assessment. Since the items related to data collection and quality were discussed in Section 2, and the risk assessment methodology was discussed in Section 3, this information will not be reiterated here. Only the results from combining the information from these two sections is described.

During the Track 2 scoping process, the historical information concerning releases at these sites was transmitted to the EPA and IDHW (ref: J. Lyle [DOE-ID] letter dated January 10, 1992 to W. Pierre [EPA Region-X] and D. Nygard [IDHW]). Since this supporting information is voluminous and has already been transmitted to the regulatory agencies, it will not be included with this Summary Report.

4.1 CPP-26 (Contaminated Soil from Steam Flushing Operation)

On May 10, 1964 while flushing a section of the HLLWTF decontamination header, radioactive steam was inadvertently released to the air through a faulty hose coupling on the decontamination header. This resulted in a release of an unknown volume of radioactively contaminated steam that is assumed to have contaminated the land surface of approximately 13 acres to the northeast of Building 635 as described in Section 1.2. Since this release, the contaminated area within the Tank Farm has been covered with 2 feet of soil, a 20-mil thick membrane liner, and an additional 6-inches of soil to prevent the liner from blowing away. Therefore, the area of suspected contamination is approximately two and a half feet below the present land surface.

According to the *Waste Tank Farm Contamination Incident of May 10, 1964*, the contamination from this release consisted primarily of "aged fission products" (i.e., radionuclides having a half-life greater than 3-5 years) with a sample of the mud colelcted near the spill containing approximately 27% Cs-137, 69% Ce-144, and 3% Ru-106 (by activity). According to this report, the radiological analysis of the "hottest" soil sample collected after the incident and the expected 1992 soil concentrations, based solely on radioactive decay, are as follows:

Contaminant	Measured 1964 Concentration (pCi/g)[1]	Calculated 1992 Concentration (pCi/g)
Pu-242	0.03	0.03
Ru-103	810	7.59E-76
Ru-106	3,600	1.97E-05
Ce-144	22,400	3.52E-07
Cs-137	520	273
Cs-134	3.3	2.74E-04

[1] Concentration based on the values reported in the *Waste Tank Farm Contamination Incident of May 10, 1964.*

It should be noted that the report is unclear whether the "hottest" sample was collected at the point of release or from outside the fence.

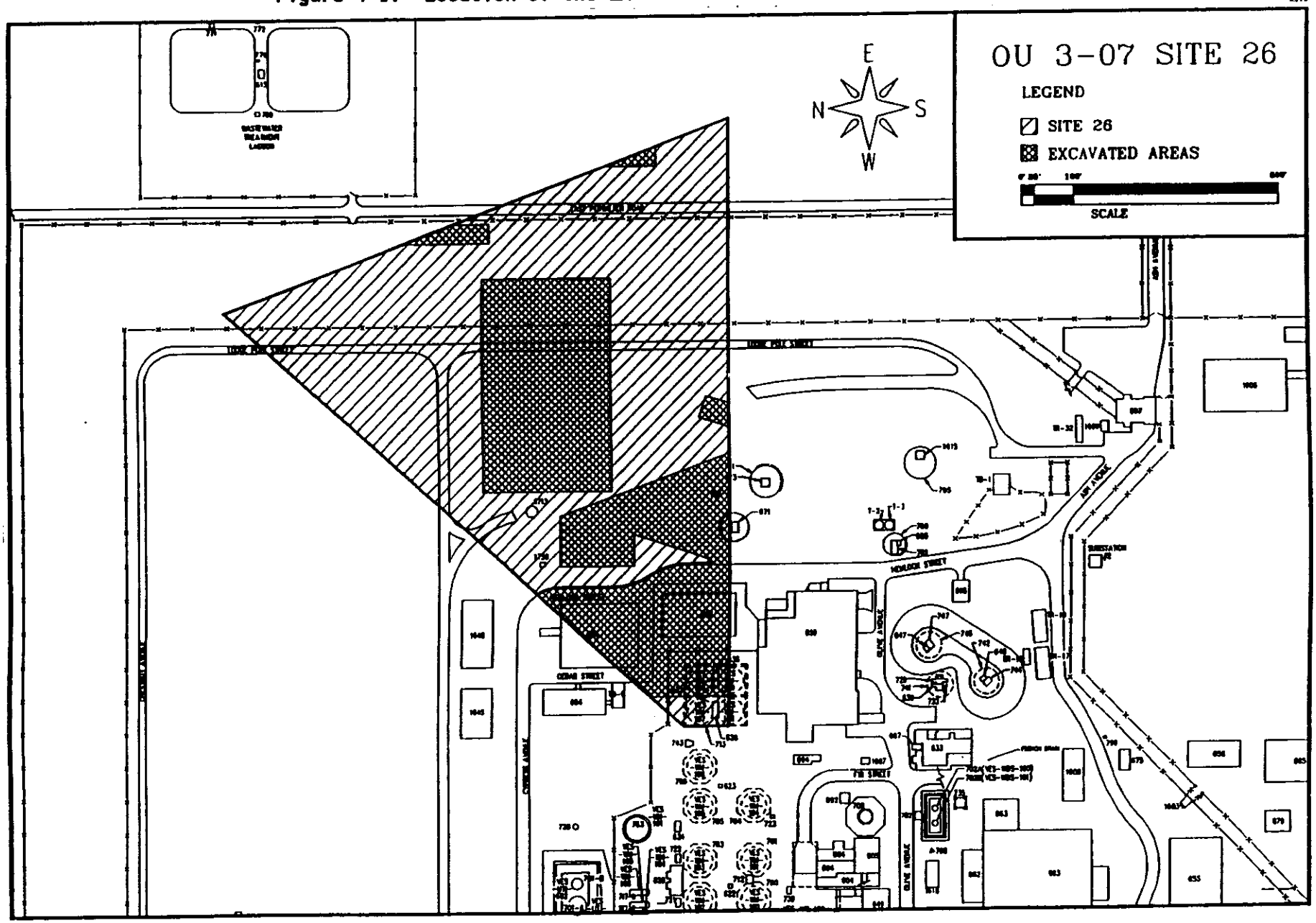
From these analyses, it is important to note that neither Sr-90 or U-235 were reported as being present in the soil. It is unclear whether these contaminants were actually present in the soil and not analyzed at the time of the incident, or whether the contaminants were not present in the waste stream. Based upon the typical composition of the waste stream, it was likely that Sr-90 was present at a concentration roughly equivalent to that of Cs-137.

Based upon the radionuclide concentrations from the "hottest" sample analyzed at the time of the incident, only Cs-137 and Pu-242 would potentially be present in the soil at detectable levels following 28 years of radioactive decay. Based on radioactive decay, it is expected that the present day concentrations of Cs-137 from this release would be less than 300 pCi/g. Pu-242 would not have decayed significantly in the 28 years since the release, however the expected present day concentration is at or below the laboratory detection limit. Therefore, it is uncertain whether Pu-242 may be present at this site below the detection limit of 0.04 pCi/g.

It should be noted that the detection limits for Pu-242 differ for the 1964 data and the 1992 data because different analytical laboratories were used.

Since the steam release in 1964, the site boundary has been reduced by approximately one-third due to subsequent construction activities in the area (Figure 4-1). The majority of the excavation within this site is associated with the construction of building CPP-699, building CPP-654, Hemlock Street, and Bin Sets 4, 5, and 6. A separate report describing the installation of tanks WM-189 and WM-190, which were being constructed at the time of the release and are located adjacent to the point of release, indicate that contaminated liquids in the excavation area were solidified and removed. In addition, CPP Gravel Pit #2 (CPP-37) was in operation at the time of the incident and now has been covered with soil. Any contaminants remaining in Pit #2 from the air release cannot be distinguished from those that may have been in the pit. As a result, any contamination found at CPP-37 will be addressed in the FFA/CO investigation for that site.

Figure 4-1. Location of the Excavated Areas Within Site CPP-26



4.1.1 Nature and Extent of Contamination

During the Track 2 investigation, three soil borings were drilled in the alluvium near the location of the steam release to determine the nature and concentration of the residual contamination. These three soil borings are located to the east and northeast of Building 635 and are shown in Figure 4-2. A total of nine soil samples, including three duplicate samples, were collected from the three soil borings and analyzed for VOCs, TAL metals, fluoride, nitrate/nitrite, pH, and radionuclides (Table 4-1). All depths described in the soil boring logs are measured from the tank farm membrane liner as the land surface (0 datum).

4.1.1.1 Volatile Organic Compounds. Of the nine samples analyzed by method SW846/8240, only toluene and acetone were present in detectable concentrations. However, acetone was also detected in the associated blank at a concentration approximately 4X the sample concentration. The detection of acetone is assumed to be from laboratory contamination and therefore, is not present at the site. Toluene was detected in all three samples from borehole CPP-26-1 at estimated concentrations ranging from 1 μg/kg to 2 μg/kg and in the 1.0 - 1.8 foot sample from borehole CPP-26-3 at an estimated concentration of 1 μg/kg. According to Data Useability for Risk Assessment (EPA 1989), toluene is also a common laboratory contaminant and may have been introduced at the laboratory rather than being present at the site. In addition, toluene is a typical component of fuels and the very low concentrations detected at the site could have been caused by vehicle exhaust or the general industrial use of the facility. Toluene contamination at these low concentrations are generally not considered to be a problem.

4.1.1.2 Inorganic Compounds. Of the five metals analyzed at this site, only chromium, manganese, and nickel had concentrations above the method detection limits. The maximum metal concentration detected in the soil and the associated background 95% UTL are:

- Chromium detected at 15.5 mg/kg compared to a background 95% UTL of 28.3 mg/kg.
- Manganese detected at 238 mg/kg compared to a background 95% UTL of 384 mg/kg.
- Nickel detected at 19.4 mg/kg compared to a background 95% UTL of 32.8 mg/kg.

Since none of the metals exceeded background concentrations, their presence does not indicate contamination. The other miscellaneous inorganics analyzed at the site (pH, nitrate, nitrite, and fluoride) were detected at concentrations within normal soil ranges and also do not indicate the presence of contamination.

4.1.1.3 Radionuclides. The field radiation surveys for gross beta-gamma are shown in Figure 4-2 with the actual measurements provided in the Borehole Logs (Appendix B). The highest levels of beta-gamma radiation were detected in boreholes CPP-26-1 and CPP-26-2 at depths greater than 4 feet bls. In borehole CPP-26-1, the highest radiation levels (greater than 50,000 cpm above background) were detected at 3.8 to 4.7 feet bls with the radiation levels decreasing to 20,000 cpm above background at a depth of 6 feet bls. In borehole CPP-26-2, the highest radiation levels (50,000 cpm above background) were detected at a depth of 4.8 feet bls and continued to the bottom of the borehole at a depth of 6 feet

Figure 4-2. Locations of the Boreholes at CPP-26 and the Subsurface Beta-Gamma Radiation Measurements

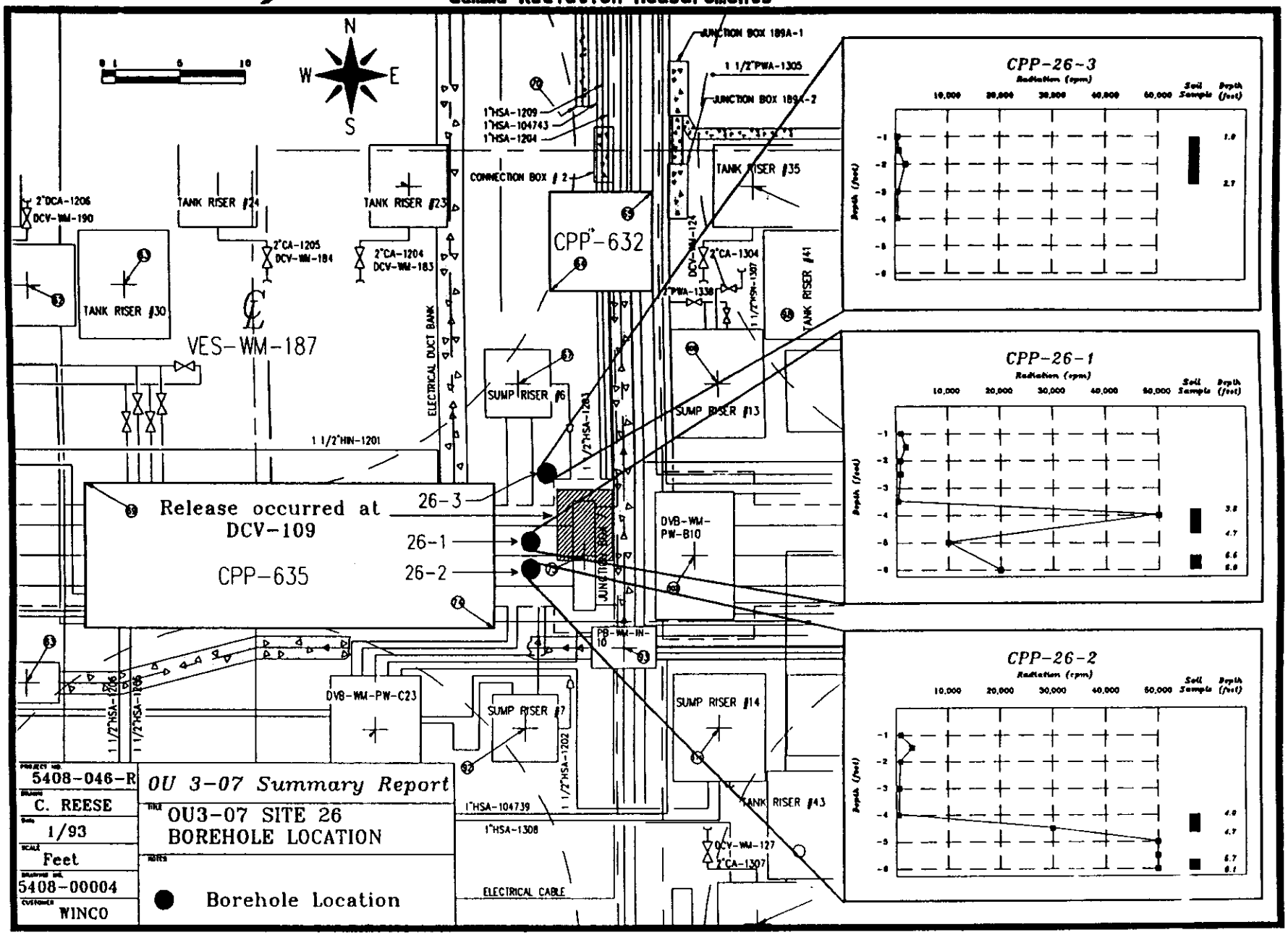


Table 4-1. Results of the Soil Analyses at CPP-26

Borehole	CPP-26-1				CPP-26-1				CPP-26-1			
Depth (feet)	(3.8 - 4.7)				(5.5 - 6.0)				(5.5 - 6.0)			
Sample Number	30700101				30700201				30700301			
	Concentration mg/Kg or pCi/g			Q	Concentration mg/Kg or pCi/g			Q	Concentration mg/Kg or pCi/g			Q
Chemical Parameters												
Toluene	2.00E-03			J	1.00E-03			J	1.00E-03			J
Chromium	1.21E+01				1.03E+01				**			
Manganese	1.99E+02			J	1.47E+02			J	**			
Mercury	2.00E-01			U	1.20E-01			U	**			
Nickel	1.75E+01			J	1.40E+01			J	**			
Nitrate	2.90E+00			J	2.70E+00			J	2.30E+00			J
Nitrite	2.10E-01			UJ	2.10E-01			UJ	2.10E-01			UJ
Fluoride	2.09E+00			J	1.74E+00			J	**			
pH	9.02E+00				9.11E+00				9.38E+00			
Radionuclides			Uncertainty				Uncertainty				Uncertainty	
Gross Alpha	1.88E+02	±	2.27E+01	J	4.64E+01	±	5.76E+00	J	4.61E+01	±	5.77E+00	J
Gross Beta	2.02E+04	±	1.62E+03		3.53E+03	±	2.83E+02		2.79E+03	±	2.24E+02	
Cs-137	6.46E+03	±	4.65E+02		9.04E+02	±	6.12E+01		6.65E+02	±	4.51E+01	
Eu-154	1.07E+01	±	9.20E-01		1.01E+00	±	1.32E-01		1.07E+00	±	1.35E-01	
K-40	1.93E+01	±	1.98E+00		1.87E+01	±	1.12E+00		1.77E+01	±	1.05E+00	
Sr-90	8.39E+03	±	1.21E+02	J	1.74E+03	±	6.84E+01	J	1.35E+03	±	3.32E+01	J
U-234	1.16E+00	±	1.35E-01		9.79E-01	±	1.07E-01		1.13E+00	±	1.13E-01	
U-235	4.54E-02	±	1.43E-02		4.97E-02	±	1.56E-02		8.16E-02	±	2.95E-02	
U-238	1.11E+00	±	1.30E-01		1.03E+00	±	1.10E-01		1.25E+00	±	1.19E-01	
Pu-238	3.58E+00	±	2.79E-01	J	2.11E-01	±	5.34E-02	J	1.89E-01	±	5.11E-02	J
Pu-239	8.41E-01	±	1.21E-01		1.32E-02	±	1.32E-03	U	4.05E-02	±	2.34E-02	U
Pu-242	NA	±	NA		NA	±	NA		NA	±	NA	
Am-241	5.74E-01	±	7.98E-02		2.33E-01	±	5.14E-02		1.73E-01	±	4.67E-02	
Borehole	CPP-26-2				CPP-26-2				CPP-26-2			
Depth (feet)	(4.0 - 4.7)				(5.7 - 6.1)				(4.0 - 4.7)			
Sample Number	30700401				30700501				30700601			
	Concentration mg/Kg or pCi/g			Q	Concentration mg/Kg or pCi/g			Q	Concentration mg/Kg or pCi/g			Q
Chemical Parameters												
Toluene	5.00E-03			U	5.00E-03			U	5.00E-03			U
Chromium	1.07E+01				1.18E+01				1.04E+01			
Manganese	2.18E+02			J	1.43E+02			J	1.38E+02			J
Mercury	1.60E-01			U	1.20E-01			U	1.50E-01			U
Nickel	1.34E+01			J	1.16E+01			J	1.25E+01			J
Nitrate	1.60E+00			J	1.90E+00			J	1.60E+00			J
Nitrite	2.10E-01			UJ	2.00E-01			UJ	2.10E-01			UJ
Fluoride	1.59E+00			J	1.58E+00			J	1.64E+00			J
pH	9.28E+00				9.32E+00				9.37E+00			
Radionuclides			Uncertainty				Uncertainty				Uncertainty	
Gross Alpha	2.33E+02	±	2.81E+01	J	1.27E+02	±	1.54E+01	J	3.02E+02	±	3.64E+01	J
Gross Beta	2.56E+04	±	2.05E+03		1.52E+04	±	1.22E+03		3.55E+04	±	2.84E+03	
Cs-137	5.33E+03	±	3.90E+02		1.38E+03	±	1.01E+02		6.73E+03	±	4.85E+02	
Eu-154	6.81E+00	±	4.91E-01		2.27E+00	±	2.28E-02		7.30E+00	±	7.32E-01	
K-40	1.68E+01	±	1.23E+00		1.87E+01	±	1.29E+00		1.86E+01	±	1.94E+00	
Sr-90	1.53E+04	±	1.46E+02	J	8.23E+03	±	1.54E+02	J	1.58E+04	±	1.06E+02	J
U-234	1.24E+00	±	1.43E-01		1.03E+00	±	1.25E-01		1.26E+00	±	1.42E-01	
U-235	5.51E-02	±	2.96E-02		7.39E-03	±	1.05E-02	U	2.27E-02	±	1.88E-02	U
U-238	7.89E-01	±	1.12E-01		9.15E-01	±	1.18E-01		1.01E+00	±	1.26E-01	
Pu-238	1.67E+00	±	1.73E-01	J	3.48E-01	±	7.09E-02	J	2.71E+00	±	2.52E-01	J
Pu-239	8.03E-01	±	9.93E-02		8.35E-02	±	3.43E-02		6.67E-01	±	1.16E-01	
Pu-242	ND	±	ND		NA	±	NA		ND	±	ND	
Am-241	5.31E-01	±	7.94E-02		1.44E-01	±	4.01E-02		3.76E-01	±	6.57E-02	

** = Contaminated during shipment
Q = Data Qualifier
ND = No Data
NA = Not Analyzed
U = Not Detected
J = Estimated concentration (below method detection limit)

Table 4-1 (Cont.). Results of the Soil Analyses at CPP-26

Borehole	CPP-26-3				CPP-26-3				CPP-26-3			
Depth (feet)	(1.0 - 1.8)				(1.8 - 2.7)				(1.8 - 2.7)			
Sample Number	30700701				30700801				30700901			
	Concentration mg/Kg or pCi/g			Q	Concentration mg/Kg or pCi/g			Q	Concentration mg/Kg or pCi/g			Q
Chemical Parameters												
Toluene	1.00E-03			J	5.00E-03			U	5.00E-03			U
Chromium	1.06E+01				1.46E+01				1.55E+01			
Manganese	1.27E+02			J	2.38E+02			J	1.94E+02			J
Mercury	2.70E-01			U	2.50E-01			U	3.00E-01			U
Nickel	1.12E+01			J	1.94E+01			J	1.83E+01			J
Nitrate	7.90E-01			J	2.20E+00			J	9.20E-01			J
Nitrite	2.10E-01			UJ	2.10E-01			UJ	2.10E-01			UJ
Fluoride	1.69E+00			J	1.92E+00			J	1.73E+00			J
pH	9.21E+00				9.17E+00				8.99E+00			
Radionuclides			Uncertainty				Uncertainty				Uncertainty	
Gross Alpha	1.60E+01	±	2.22E+00	J	4.15E+01	±	5.27E+00	J	2.33E+01	±	3.00E+00	J
Gross Beta	1.51E+02	±	1.24E+01		5.79E+02	±	4.66E+01		4.51E+02	±	3.64E+01	
Cs-137	1.08E+02	±	9.08E+00		2.59E+02	±	1.87E+01		1.76E+02	±	1.19E+01	
Eu-154	1.63E-01	±	4.36E-02		6.52E-01	±	3.81E-02		6.13E-01	±	7.10E-02	
K-40	2.17E+01	±	1.06E+00		2.09E+01	±	1.02E+00		1.69E+01	±	8.55E-01	
Sr-90	3.38E+01	±	2.31E+00	J	2.10E+02	±	7.70E+00	J	1.46E+02	±	5.82E+00	J
U-234	NA	±	NA		2.21E+00	±	1.38E-01		1.42E+00	±	9.46E-02	
U-235	NA	±	NA		1.04E-01	±	2.55E-02		4.97E-02	±	1.56E-02	
U-238	NA	±	NA		1.03E+00	±	8.56E-02	J	9.28E-01	±	7.24E-02	J
Pu-238	NA	±	NA		3.09E+00	±	1.91E-01		8.38E-01	±	7.65E-02	
Pu-239	NA	±	NA		1.59E-01	±	3.31E-02		9.63E-02	±	2.37E-02	
Pu-242	NA	±	NA		NA	±	NA		NA	±	NA	
Am-241	NA	±	NA		1.34E+00	±	8.66E-02		6.39E-01	±	7.44E-02	

Q = Data Qualifier
NA = Not Analyzed
U = Not Detected
J = Estimated concentration (below method detection limit)

bls. The highest beta-gamma radiation detected in borehole CPP-26-3 was 2000 cpm above background at a depth of 1.8 to 2.7 feet bls and decreased to 500 cpm above background to the bottom of the borehole at a depth of 4 feet bls. Since an increase in radioactivity was noted in the other boreholes at 4 feet bls, this borehole may not have extended deep enough to encounter the highest potential contamination.

Soil samples for laboratory analysis were collected from the intervals having the highest measured gross beta-gamma radiation as shown in Figure 4-2. The gross alpha concentrations varied between 16 pCi/g and 302 pCi/g and the gross beta concentrations varied from 451 pCi/g to 35,500 pCi/g. Since these concentrations were above the screening criteria of 20 pCi/g alpha and 30 pCi/g beta, isotopic analyses were performed on all samples except sample number 3070071. Since the beta activity exceeded background for this sample, isotopic analysis was only performed for the beta-emitting radionuclides. To assist in the risk assessment, the results of the radionuclide analyses for all samples are summarized in Table 4-2. When two analyses are available from the same interval (i.e., an original and duplicate sample), the average and upper 95% confidence limit concentrations presented in Table 4-2 are calculated using an average concentration from the two analyses for that specific sample interval.

According to the field measurements of beta-gamma radiation, the radioactivity significantly increases at a depth of approximately 4 feet bls as shown in the Borehole Logs (Appendix B). Only three samples (30700701, 30700801, and 30700901 from borehole CPP-26-3) were collected at a depth of less than 4 feet bls. The range of activities for the radionuclides detected in the upper four feet are shown in Table 4-2. Since similar gross beta-gamma radiation levels were also measured in the other two boreholes (CPP-26-1 and CPP-26-2) from the 0 to 4 foot depth, these concentrations are probably representative of the levels of contamination in the upper four feet.

The highest concentrations for most radionuclides were detected in boreholes CPP-26-1 and CPP-26-2 at a depth between 4 and 5 feet bls. For the soil samples collected below this depth, from approximately 5.5 to 6 feet bls, the radionuclide concentrations decrease. This indicates that the release probably occurred near the surface and that the concentration of radionuclides would likely continue to decrease with depth.

4.1.1.4 Nature and Extent Conclusions. Given the type of release that occurred in 1964, this site consists of two separate areas: 1) the area outside the Tank Farm that was contaminated by only a steam release and 2) the area inside the Tank Farm that was contaminated by both a steam and liquid release (Figure 1-3). Based on the results from the Track 2 investigation and the ICPP surface radiation surveys, it appears that the contamination at this site is better addressed as two separate areas.

The contamination detected in the three boreholes may not be related to the contamination resulting from the steam release at site CPP-26. According to an analysis of the mud at the time of the release, the contamination at this site consists of aged fission products, primarily various isotopes of ruthenium, cerium, and cesium, and low concentrations of Pu-242. Based upon radioactive decay, all radionuclides except Cs-137 would have decayed to extremely low concentrations in the soil. Pu-242 would not have decayed significantly during the 28 years since the release, however the original concentration detected in

Table 4-2. Summary of the Radionuclide Analyses for Site CPP-26

Entire Sample Population	Cs-137 (pCi/g)	Eu-154 (pCi/g)	Sr-90 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Pu-238 (pCi/g)	Pu-239 (pCi/g)	Am-241 (pCi/g)
Number of Samples	6	6	6	5	5	5	5	5	5
Minimum Concentration	108	0.163	33.8	0.979	0.00739	0.789	0.189	0.0132	0.144
Maximum Concentration	6460	10.70	15,800	2.21	0.104	1.25	3.58	0.841	1.34
Average Concentration	2497	3.64	5654	1.26	0.05	1.01	1.66	0.34	0.47
95% Upper Confidence Limit	4917	7.16	10,732	1.57	0.07	1.11	3.00	0.70	0.80
Sample Population (0-4 feet)									
Number of Samples	3	3	3	2	2	2	2	2	2
Minimum Concentration	108	0.163	33.8	1.42	0.0498	0.928	0.838	0.0963	0.639
Maximum Concentration	259	0.652	210	2.21	0.104	1.03	3.09	0.159	1.34

Concentrations based on an average of the original and duplicate samples for a given interval, when analyzed.

The 95% Upper Confidence Limit is calculated as follows:

$$CI_{0.95} = \overline{X} + t_{0.025}\frac{S}{\sqrt{n}}$$

where: $\overline{X}$ = sample average
$t_{0.025}$ = student's "t" value for the appropriate degrees of freedom
S = standard deviation
n = number of samples

If two samples were collected from the same interval (i.e., original and replicate sample), the concentration used for that sample location was an average of the two samples.

the soil in 1964 is below the laboratory method detection limit. Using the Cs-137 concentration reported for the "hottest" sample following the incident, the maximum expected Cs-137 concentration for the Track 2 investigation would be approximately 300 pCi/g.

The radionuclides detected in the soil during the Track 2 investigation consist primarily of Sr-90, Cs-137, Eu-154, and very low levels of Pu-238, Pu-239, and Am-241. The maximum concentration detected for Cs-137 was 6460 pCi/g, approximately one order of magnitude higher than what would be expected based on radioactive decay of the "hottest" sample at the time of release. In addition, a significant increase in gross beta-gamma radioactivity was measured at a depth of approximately 4 feet bls. The original land surface at the time of the release (prior to membrane installation), is now located at a depth of 2½ feet bls. Given the abrupt change in the gross radioactivity at a depth of four feet, it does not appear likely that the radionuclides have migrated downward from the original land surface. This is because if contaminant migration were occurring, a gradual increase in concentrations with depth would be expected rather than the abrupt increase that was noted at this site. It is possible that the upper two feet of soil was cleaned up following the incident, however there is no documentation supporting this conclusion. Based upon the above discussion, it is uncertain whether the contamination detected from the three boreholes is from the CPP-26 steam release.

For the area of contamination outside the tank farm, the original area release was estimated to have contaminated 13 acres to the northeast of building 635 based upon air dispersion. Surface radiation surveys outside the tank farm boundary following the incident in 1964 detected between 2 and 10 mrem/hr in the soil, with one area having as high as 200 mrem/hr of gross radioactivity. The surface radiation survey and clean up program performed in 1991 by the ICPP maintenance program did not detect elevated gross beta-gamma radiation in the soil outside the tank farm that has not been disturbed since the steam release (Figure 4-3). Based upon 28 years of radioactive decay since the time of the release and the results from recent surface radiation surveys, it does not appear that surface contamination remains in the soil outside the tank farm.

4.1.2 Quantification of Exposure

The potential risk at this site is from exposure to radionuclides. The soil concentrations for all of the radionuclides detected, except U-238, are greater than the background concentrations provided in Table 3-1. The U-234 and U-235 soil concentrations are slightly higher than background in several samples and therefore, are retained for further evaluation along with Sr-90, Cs-137, Eu-154, Pu-238, Pu-239, and Am-241.

Under the current occupational scenario, the soil ingestion and inhalation of fugitive dust pathways are not complete since the soil contamination was detected below a depth of 6 inches. For the external exposure pathway, the maximum soil concentration for each radionuclide detected in the upper four feet of soil, as described in Section 4.1.1.3, was used to calculate the lifetime exposure rate (Table 4-3).

All exposure pathways evaluated for the future residential scenario are complete. However, it was not possible to calculate the lifetime intake rates for the fugitive dust or ground water pathways since the surface area or source volume of contamination, respectively, are unknown. For the soil ingestion and

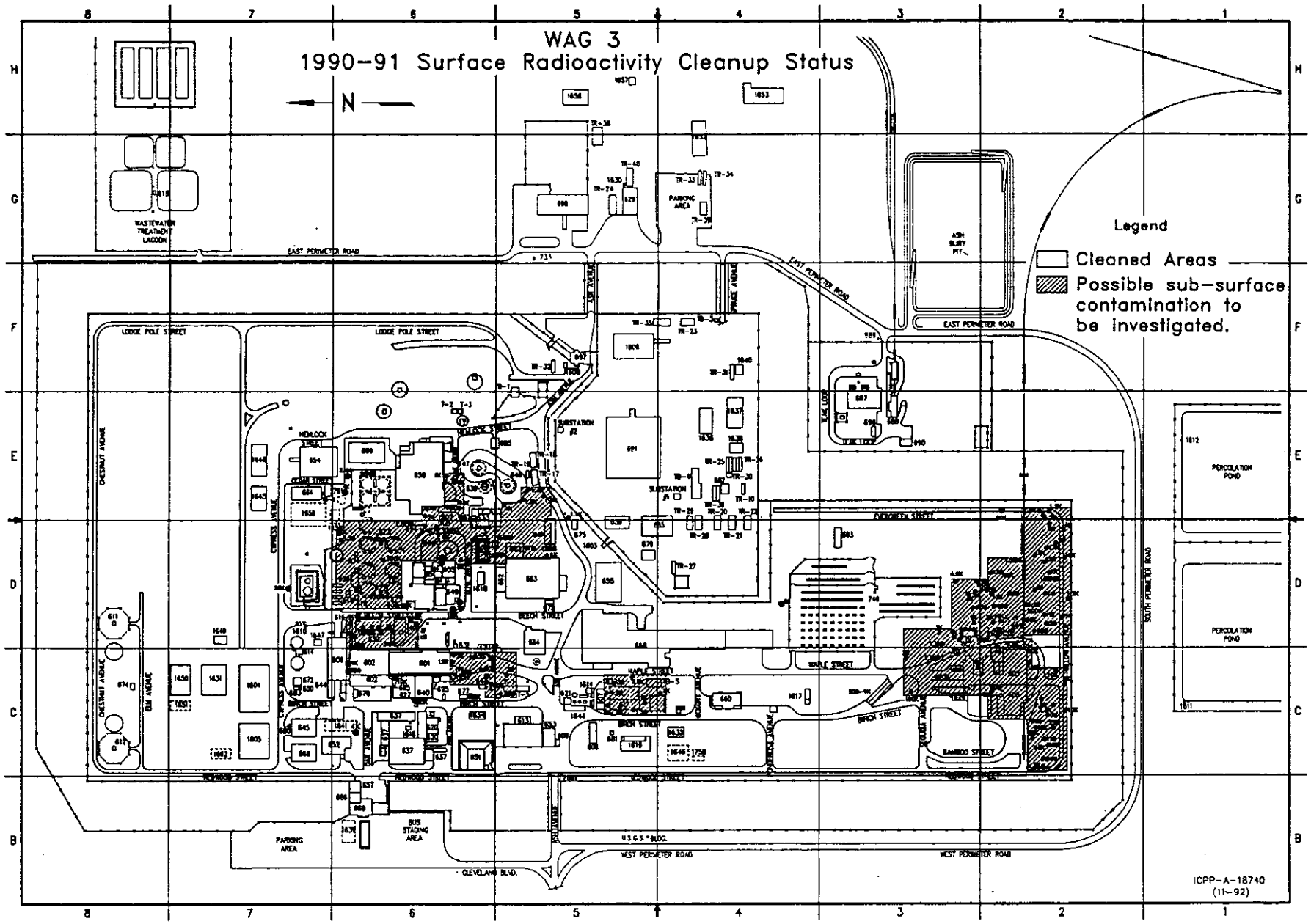

WAG 3
1990–91 Surface Radioactivity Cleanup Status
N
Legend
Cleaned Areas
Possible sub–surface contamination to be investigated.
EAST PERIMETER ROAD
LODGE POLE STREET
CHESTNUT AVENUE
ELM AVENUE
BIRCH STREET
MAPLE STREET
EVERGREEN STREET
BAMBOO STREET
SOUTH PERIMETER ROAD
WEST PERIMETER ROAD
CLEVELAND BLVD.
PARKING AREA
BUS STAGING AREA
ASH SLURY PIT
PERCOLATION POND
PERCOLATION POND
WASTEWATER TREATMENT LAGOON
SUBSTATION #2
SUBSTATION #1
U.S.G.S. BLDG.
ICPP–A–18740
(11–92)

Table 4-3. Lifetime Intake and Exposure Table for CPP-26

OU: 3-07 Site: CPP-26

Contaminant	Source SC (pCi/g or mg/kg)	Current Occupational Scenario			Future Residential Scenario						Future Recreational Scenario		
		Soil Ingestion	Inhalation of Fugitive Dust	External Exposure	Soil Ingestion	Inhalation of Fugitive Dust	Ground Water Ingestion			External Exposure	Soil Ingestion	Inhalation of Fugitive Dust	External Exposure
		Intake (pCi)	Intake (pCi)	(pCi-yr/g)	Intake (pCi)	Intake (pCi-yr/g)	Travel Time (years)	Half-life (years)	Intake (pCi)	(pCi-yr/g)	Intake (pCi)	Intake (pCi)	(pCi-yr/g)
Strontium-90	2.1E+02(1) 1.1E+04(2)	(3)	(3)	(4)	1.2E+03	(5)	NA		(5)	(4))	(3)	(3)	(4)
Cesium-137	2.6E+02(1) 4.9E+03(2)	(3)	(3)	1.5E+03	3.2E+06	(5)	NA		(5)	7.2E+04	(3)	(3)	3.5E+00
Europium-154	6.5E-01(1) 7.2E+00(2)	(3)	(3)	3.7E+00	8.8E+02	(5)	NA		(5)	2.0E+01	(3)	(3)	1.7E-03
Uranium-234	2.2E+00(1) 1.6E+00(2)	(3)	(3)	1.3E+01	2.0E+03	(5)	NA		(5)	4.6E+01	(3)	(3)	6.0E-02
Uranium-235	1.0E-01(1) 7.0E-02(2)	(3)	(3)	5.9E-01	9.1E+01	(5)	NA		(5)	2.0E+00	(3)	(3)	2.8E-03
Plutonium-238	3.1E+00(1) 3.0E+00(2)	(3)	(3)	1.8E+01	3.1E+03	(5)	NA		(5)	6.9E+01	(3)	(3)	6.6E-02
Plutonium-239	1.6E-01(1) 7.0E-01(2)	(3)	(3)	9.1E-01	9.1E+02	(5)	NA		(5)	2.0E+01	(3)	(3)	4.3E-03
Americium-241	1.3E+00(1) 8.0E-01(2)	(3)	(3)	7.6E+00	9.9E+02	(5)	NA		(5)	2.2E+01	(3)	(3)	3.4E-02

SC = Soil Concentration (mg/kg for nonradioactive; pCi/g for radioactive)
NA = Not available

1 Occupational and Recreational Scenarios (maximum concentration detected in the upper four feet).
2 Residential Scenario (upper 95% confidence limit concentration from all samples measured in the upper ten feet).
3 Pathway not complete (no contamination in upper 6 inches).
4 No gamma emissions, pathway not complete.
5 Contamination source volume unknown and therefore, lifetime intake cannot be calculated.

external exposure pathways, the lifetime intake rate was calculated using the concentration that corresponds to the upper 95% confidence limit of the arithmetic mean for all samples analyzed. This should provide a reasonable estimate for the exposure concentration in the upper 10 feet of soil.

For the future recreational scenario, the inhalation of fugitive dust pathways are not complete because the depth of contamination is greater than 6 inches. The two complete pathways for this scenario include soil ingestion and external exposure. The maximum soil concentrations of each radionuclide detected in the upper four feet, as described in Section 4.1.1.3, were used to calculate the lifetime intake rates (Table 4-3).

4.1.3 Risk Characterization Summary

Cancer risks, calculated from the estimated lifetime intake values, are summarized by scenario and exposure pathway in Table 4-4.

The only complete pathway for the current occupational scenario is from external exposure. The cumulative risk from this pathway is 3.0E-03, with exposure to Cs-137 at a soil concentration of 260 pCi/g presenting the most significant risk (3.0E-03). The risks from all other radionuclides are less than 1E-04.

For the future residential scenario, the cumulative risks for the two pathways evaluated are 3.1E-04 for soil ingestion, and 1.3E-01 due to external exposure. Of the radionuclides evaluated, Sr-90 and Cs-137 present the most significant risks in the soil ingestion pathway (2.2E-04 and 9.0E-05, respectively). The risks from all other radionuclides in the soil ingestion pathway are less than 1E-06. The risk (2.9E-02) for future residential receptors is from external exposure to Cs-137, with the risk from all other radionuclides being less than 1E-04.

Only the external exposure pathway was complete for the future recreational scenario. The cumulative risk for this pathway is 7.0E-06.

4.1.4 Uncertainty Discussion

The primary uncertainty associated with CPP-26 is due to the discrepancies in the analytical data of the mud sample at the time of the original release and the 1992 soil sample data as described in Section 4.1.1.4. Since it is uncertain whether the contamination detected in the boreholes is from the steam release or a different release, an estimate of the source volume and contaminated area is not provided. Therefore, no risk calculation for fugitive dust inhalation or ground water ingestion is presented at this time.

An additional discussion of the site-specific uncertainties associated with the risk calculations are provided in Table 4-5. In summary, if the source for the contamination was the steam release, the uncertainty has a moderate to high potential to overestimate the risk.

Table 4-4. Risk Assessment Summary Table for CPP-26

OU: 3-07 Site: CPP-26

Contaminant	Source SC (pCi/g or mg/kg)	Current Occupational Scenario			Future Residential Scenario						Future Recreational Scenario		
		Soil Ingestion	Inhalation of Fugitive Dust	External Exposure	Soil Ingestion	Inhalation of Fugitive Dust	Ground Water Ingestion			External Exposure	Soil Ingestion	Inhalation of Fugitive Dust	External Exposure
		Cancer risk	Cancer risk	Cancer risk	Cancer risk	Cancer risk	Travel Time (years)	Half-life (years)	Cancer risk	Cancer risk	Cancer risk	Cancer risk	Cancer risk
Strontium-90 +d	2.1E+02(1) 1.1E+04(2)	(3)	(3)	(4)	2.2E-04	(5)	NA		(5)	(4)	(3)	(3)	(4)
Cesium-137 +d	2.6E+02(1) 4.9E+03(2)	(3)	(3)	3.0E-03	9.0E-05	(5)	NA		(5)	1.3E-01(6)	(3)	(3)	7.0E-06
Europium-154	6.5E-01(1) 7.2E+00(2)	(3)	(3)	1.5E-05	2.6E-09	(5)	NA		(5)	8.0E-05	(3)	(3)	6.8E-09
Uranium-234	2.2E+00(1) 1.6E+00(2)	(3)	(3)	3.8E-10	3.3E-08	(5)	NA		(5)	1.4E-09	(3)	(3)	1.8E-12
Uranium-235 +d	1.0E-01(1) 7.0E-02(2)	(3)	(3)	1.4E-07	1.5E-09	(5)	NA		(5)	4.9E-07	(3)	(3)	6.7E-10
Plutonium-238	3.1E+00(1) 3.0E+00(2)	(3)	(3)	4.9E-10	6.8E-07	(5)	NA		(5)	1.9E-09	(3)	(3)	1.8E-12
Plutonium-239	1.6E-01(1) 7.0E-01(2)	(3)	(3)	1.5E-11	2.1E-07	(5)	NA		(5)	3.4E-10	(3)	(3)	7.3E-14
Americium-241	1.3E+00(1) 8.0E-01(2)	(3)	(3)	3.7E-08	2.4E-07	(5)	NA		(5)	1.1E-07	(3)	(3)	1.7E-10
CUMULATIVE SUM				3.0E-03	3.1E-04					1.3E-01(6)			7.0E-06

SC = Soil Concentration (mg/kg for nonradioactive; pCi/g for radioactive) NA = Not Applicable +d Includes risk due to progeny.

1 Occupational and Recreational Scenarios (maximum concentration detected in the upper four feet).

2 Residential Scenario (upper 95% confidence limit concentration from all samples measured in the upper ten feet).

3 Pathway not complete (no contamination in upper 6 inches).

4 No gamma emissions, pathway not complete.

5 Contamination source volume unknown and therefore, risk cannot be calculated.

6 Calculated risks using the multi-stage model were greater than 0.01. Risks shown were collected using the one-hit model equation (Risk = $1-\exp^{(-CDI \times SF)}$) (USEPA 1989).

Table 4-5. Uncertainty Assessment for Site CPP-26

Assumption	Effect on Exposure[1]		
	Potential Magnitude for Over-Estimation of Exposure	Potential Magnitude for Under-Estimation of Exposure	Potential Magnitude for Over- or Under-Estimation of Exposure
Environmental Sampling and Analysis			
Contamination detected may not be from release being investigated			Moderate to High
Sufficient samples may not have been collected to characterize the media being evaluated, especially with respect to currently available soil data.			Moderate
Exposure Parameter Estimation			
The standard assumptions regarding body weight, period exposed, life expectancy, population characteristics, and lifestyle may not be representative of any actual exposure situation.	Moderate		
The amount of media intake is assumed to be constant and representative of the exposed population.	Moderate to High		
Assumption of daily lifetime exposure for residents	Moderate to High		

[1]As a general guideline, assumptions marked as "low" may affect estimates of exposure by less than one order of magnitude; assumptions marked "moderate" may affect estimates of exposure by between one and two orders of magnitude; and assumptions marked "high" may affect estimates of exposure by more than two orders of magnitude (EPA 1989).

4.1.5 Human Health Assessment

For the current occupational receptor, the only complete pathway for exposure to contaminants at this site is from external exposure. The risk is calculated assuming that a current occupational receptor is subjected to the contamination for the exposure duration of 8 hours/day, 250 days/year for 25 years without any institutional controls. The cumulative risk based on these exposure parameters is 3.0E-03, with the risk being due to the presence of Cs-137 at a concentration of 260 pCi/g. However, current institutional controls restricts entry to the Tank Farm, and closely monitors radiation doses received by any occupational receptors. Given these institutional controls, this exposure scenario is highly unlikely within the Tank Farm area.

Because of the unknown contaminated source volume, the only exposure pathways evaluated for the future residential scenarios are soil ingestion and external exposure. A future residential receptor would be exposed to a cumulative risk for all radionuclides in both of these pathways of 1.3E-01. This risk assumes that the receptor is subjected to all contaminants detected in the soil at an exposure concentration equal to the upper 95th percent confidence limit from all samples collected in the upper 10 feet and using the default parameters described in Section 3.

For the future recreational receptor, the only complete pathway for exposure to contaminants at this site is from external exposure. The risk calculated for this pathway using the highest concentration detected in the upper four feet is 7.0E-06.

4.2 CPP-28 (Contaminated Soil South of WM-181 by Valve Box A-6)

On October 1, 1974, during the installation of a cathodic protection electrode in the tank farm area, highly radioactive contaminated soil, up to 40 rem/hr, was encountered at a depth of approximately 6 feet bls. According to the report titled *ICPP Tank Farm Contaminated Soil Incident, October 1, 1974 (SOOR 74-27)* this contamination resulted from a leak of approximately 120 gallons of high-level-radioactive liquid waste containing approximately 6000 curies of gross radionuclides from 3-inch diameter stainless steel transfer line PWA-1005. This line was used to transfer radioactive first-cycle-extraction waste solutions from the uranium recovery process to the underground 300,000 gallon storage tanks in the tank farm.

The leak from line PWA-1005 was later determined to be from a ⅛-inch diameter hole inadvertently drilled through one side of the 3-inch stainless steel pipe at approximately the horizontal center line during the original construction in 1955. The location of the hole in the pipe was such that leakage would not occur until the liquid in the pipe reached a 50%-full level, a condition only achieved when the downstream block valves were left unopened during waste transfer. Normally, any leakage would have been contained within the pipe encasement and routed downstream to collection sumps. However, inspections at the time of the incident determined that the encasements were deteriorated such that liquid was released through the joints to the surrounding soil.

Following the discovery of contaminated soil, six soil borings were drilled on October 10, 1974 and one soil sample per boring was collected from the bottom of each borehole. The location of the boreholes, designated as BH-1 through BH-5

and BH-7, are shown in Figure 4-4. The depth of sample collection for the beta-gamma radiation measurements are as follows:

- BH-1 sample collected at 7 feet bls
- BH-2 sample collected at 10 feet bls
- BH-3 sample collected at 10 feet bls
- BH-4 sample collected at 6.5 feet bls
- BH-5 sample collected at 10 feet bls
- BH-7 sample collected at 9.5 feet bls

Only the soil sample from boring BH-4 indicated radiological contamination at a level of 40 rem/hr beta-gamma on contact. No isotopic analysis were performed on any of the soil samples.

On October 22, 1974, the area around transfer line PWA-1005 was excavated (as shown in Figure 4-4) to determine the cause of the release. Whenever visual observations of the encasement indicated the possibility for liquid release (i.e., joint separations), several boreholes were hand augered to depths of three feet below the pipe to test for contamination. During the trenching operation, only one area of contamination was encountered as shown in Figure 4-4. Approximately 56 yd^3 of contaminated soil having an estimated 3000 curies of gross radioactivity was removed from this area and transported to the Central Burial Grounds in 28 Dempster-Dumpster (D-D) loads. Samples taken from several of the D-D containers had the following distribution of radionuclides: 0.2% Mn-54, 0.5% Co-60, 3.2% Ru/Rh-106, 1.4% Cs-134, 12.2% Cs-137, 21.4% Ce/Pr-144, 1.3% Eu-154, 0.8% Eu-155, and 59% Sr/Y-90. No contaminated soil was removed from below the encasement, a depth of approximately 6.5 feet, due to high levels of radioactivity in the soil. The excavated area was subsequently backfilled.

Following the completion of the trenching operation, eleven "observation wells" were installed to measure the levels of radiation below the encasement. The location of these "observation wells" are shown in Figure 4-4 with the resulting radiation measurements provided in Table 4-6. From these eleven "observation wells", significant subsurface radiation was detected in wells No. 4, No. 8, No. 10, and No. 11. The vertical extent of contamination appeared to extend to a depth of two feet below the encasement, or approximately nine feet bls. Following the completion of this investigation, these "observation wells" were supposedly cutoff below grade and abandoned. No additional historical information is available concerning the abandonment of the "observation wells".

Figure 4-4. Location of the "Observation Wells", Boreholes and Excavations Associated with Site CPP-28 Following the Release.

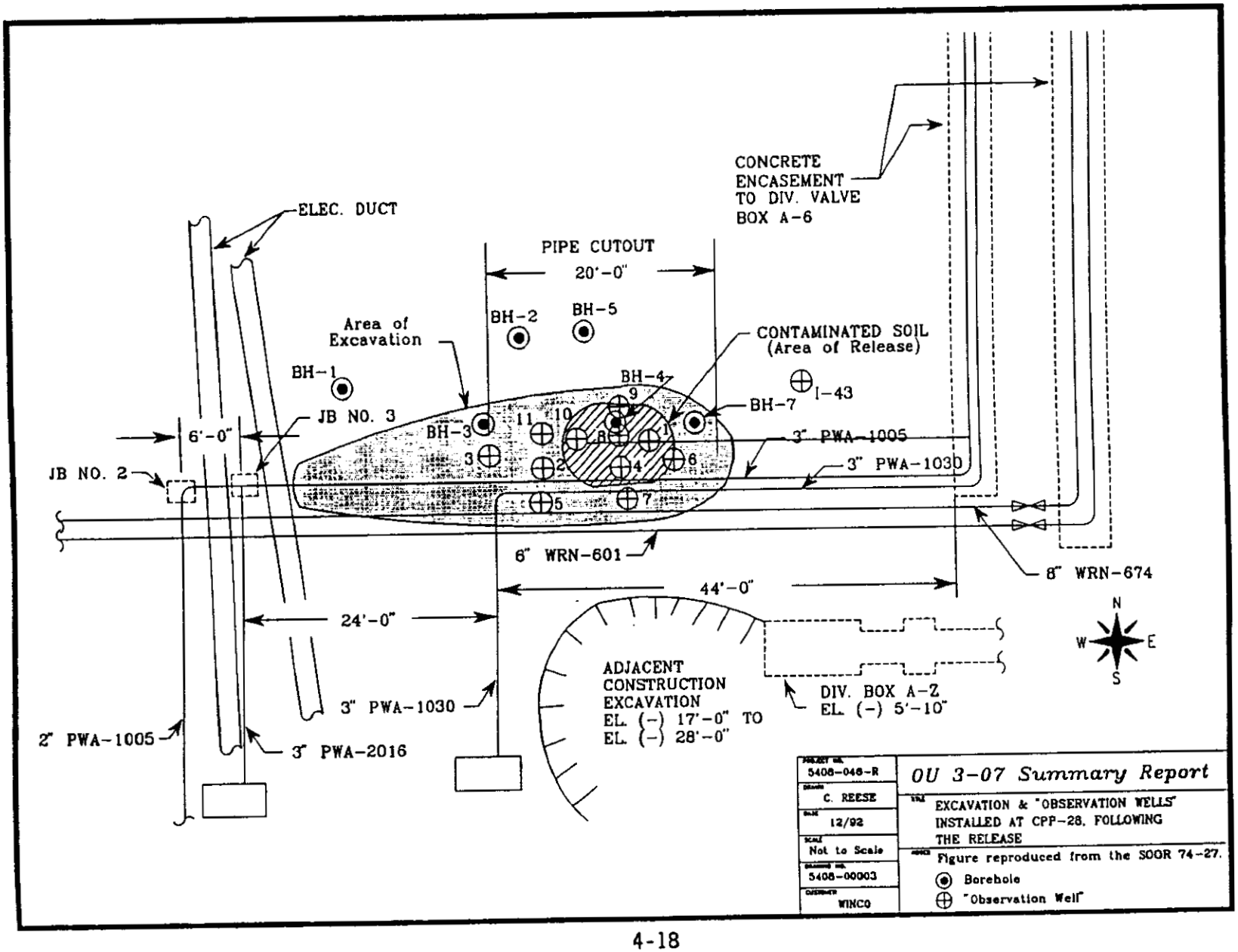


Table 4-6. Gross Radiation Measurements of the Subsurface at Site CPP-28 Following the Discovery of the Release.

"Observation Well" Radiation Readings (mR/hr)											
Elevation	No.1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11
0'-0"					30						
(-) 1'-0"	35				35	25	20	40	10	40	40
(-) 2'-0"	35	50	25	60	50	30	15	50	40	40	40
(-) 3'-0"	35	50	25	70	60	35	6	70	40	40	50
(-) 4'-0"	35	50	25	100	60	70	2	80	40	50	60
(-) 5'-0"	30	50	25	150	70	200	3	100	40	60	50
(-) 6'-0"	7	200	18	200 1500	60	250	10	350 2000	12	90	150
(-) 7'-0"	7	1500	3	5500 35000	100	150	10	7000 12000	8	350	5000
(-) 8'-0"	7	300	2	20000 3000	2000	40	10	90000 65000	8	11000 50000	11000
(-) 9'-0"	50	60	1	800	50	20	50	10000	6	4000	250
(-) 10'-0"	40	5	0.6	100	20	4	250	12		50	10
(-) 11'-0"	20	5	0.5	10	50	1	50	4	<5	7	2
(-) 12'-0"	10	1.5	<0.5	6	50	<1	12	2		1	<1

During the 1992 Track 2 investigation, an attempt was made to locate the abandoned "observation wells" so that additional subsurface radiation readings could be collected. These measurements were intended to 1) determine the current levels of gamma radiation and 2) determine whether the gamma-emitting radionuclides, primarily Cs-137, have migrated. The radionuclide Cs-137 was targetted for this investigation based upon the composition of the waste stream where Cs-137 would comprise approximately 99% of the total gamma radiation that may be present in the soil. As a result, Cs-137 would be the primary gamma-emitting radionuclide detected in the "observation wells" during the radiation profiling.

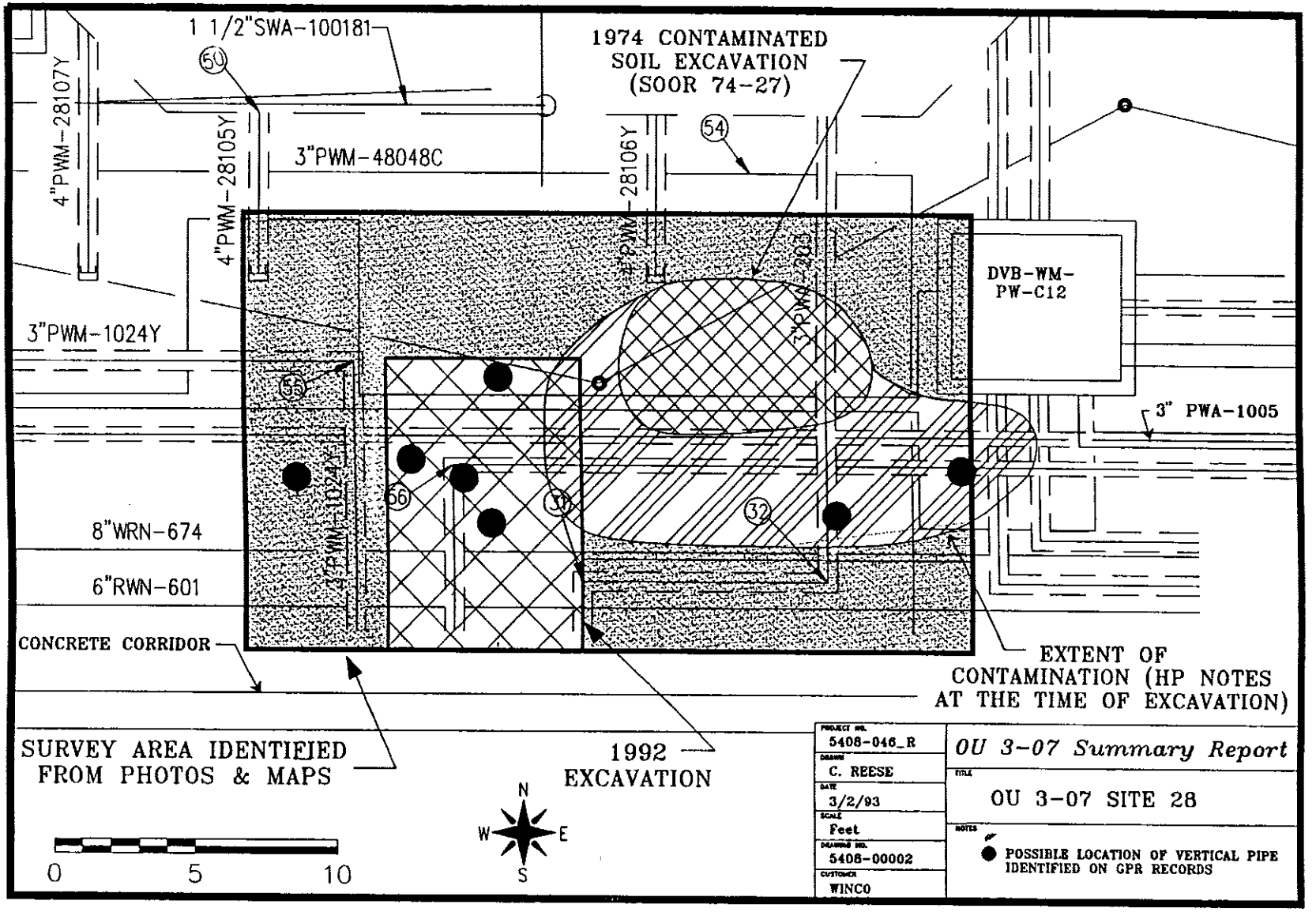
From August 20 - 24, 1992, an area measuring approximately seven feet by ten feet was excavated to a depth of seven feet bls that was believed to be in the vicinity of the former "observation wells" (Figure 4-5). The general area for the excavation was determined by 1) reviewing historical plant drawings that depicted the original locations, 2) reviewing photographs taken during the project, and 3) performing surface geophysical surveys. Prior to running the surface geophysical surveys, the target area was initially identified by reviewing historical photographs that showed the location of the "observation wells" prior to burial. Once the target area was identified, from available records, surface geophysical surveys were performed using ground penetrating radar (GPR), electromagnetics (EM), and a magnetometer.

The results from the GPR detected anomalies in the same general pattern as the "observation wells" (Figure 4-5). The location for the excavation was then based on the agreement between the GPR anomalies and the estimated location for the "observation wells". The "observation wells" were not located after three days of excavation and at the time, it was thought that they may have been removed from the ground following the initial investigation and cleanup. Further evaluation of this site during the Summary Report determined that the excavated area and the location of the "observation wells" did not coincide. Therefore, it is uncertain whether these "observation wells" still exist at the site.

4.2.1 Nature and Extent of Contamination

According to the *ICPP Tank Farm Contaminated Soil Incident, October 1, 1974 (SOOR 74-27)*, approximately 120 gallons of first-cycle raffinate waste containing an estimated 6000 curies (46 curies/gallon) of gross radioactivity was released from the pipe between 1955 and 1974. During trenching in 1974, an estimated 3000 curies of gross radioactivity was removed in the 56 yd^3 of contaminated soil taken to the Central Burial Grounds. Therefore, an estimated 4.7 yd^3 of contaminated soil having 3000 curies of gross radioactivity in 1974 was left in place in an area approximately nine feet in diameter by two feet in average depth below the pipe encasement.

Figure 4-5. Location of the Geophysical Surveys and Excavation Performed During the Track 2 Investigation.



Assuming that the 3000 curies of gross radioactivity are uniformly distributed throughout the 4.7 yd^3 of soil, and a soil density of 1.9 g/cm^3, the resultant activity for all the radionuclides released at this site would be 435.6 μCi/g. To estimate the activity for the individual isotopes, the average percent distribution of the radionuclides present in the first-cycle raffinate wastes as measured in tanks WM-185, WM-187, and WM-188 on September 15, 1971 was used (Memorandum dated August 7, 1972 from D. W. Rhodes to Distribution [Rhod-4-72]). The activity for each isotope was then calculated using the average percent distribution of the waste within these tanks multiplied by the total soil activity of 435.6 μCi/g. The 1992 activities were determined from the calculated 1974 activities and adjusted for 18 years of radioactive decay. The calculated 1974 and 1992 soil activities are as follows:

Table 4-7. Estimated Soil Contamination at CPP-28.

Radionuclide	Estimated 1974 Soil Concentration (pCi/g)	Calculated 1992 Soil Concentration (pCi/g)
Co-60	2.43E+05	2.27E+04
Zr-95	9.07E+05	1.00E-25
Nb-95	1.17E+06	1.11E-51
Ru-106	1.41E+07	5.41E+01
Sb-125	5.00E+06	2.18E-202
Cs-134	3.32E+07	7.55E+04
Cs-137	1.55E+08	1.02E+08
Ce-144	1.32E+08	1.44E+01
Eu-154	2.41E+06	5.65E+05
Sr-90	8.85E+07	5.68E+07
Tritium	6.86E+04	2.49E+04
Np-237	1.63E+00	1.63E+00
Pu-239	1.26E+04	1.26E+04
Pu-240	1.23E+04	1.22E+04
Pu-241	2.49E+06	1.05E+06
Pu-242	3.20E+01	3.20E+01
U-234	2.12E+01	2.12E+01
U-235	2.41E-01	2.41E-01
U-236	7.55E-01	7.55E-01
U-238	4.51E-02	4.51E-02

No attempt was made to estimate the soil concentration of metals or organic compounds that may have been released at this site. Insufficient analytical data is available on the first cycle raffinate to estimate the possible soil concentrations.

4.2.2 Quantification of Exposure

The estimated soil concentrations for all of the radionuclides, except U-238, are greater than the background concentrations as provided in Table 3-1. Since the top of the contamination is approximately 9 feet bls, screening by pathway eliminated both the current occupational and future recreational scenarios for this site. This is because the depth of contamination is greater than six inches for the inhalation and soil ingestion pathways and greater than four feet for the external exposure pathway.

All exposure pathways evaluated for the future residential scenario (i.e., to begin in the year 2092) are complete. The calculated soil concentrations of Zr-95, Nb-95, and Sb-125 for the year 2092 are much less than 1% of the original concentrations due to radioactive decay and would only be present in very small concentrations (ranging from 1E-202 to 1E-25 pCi/g). Therefore, these radionuclides were not evaluated further. The peak water concentrations calculated using GWSCREEN for Co-60, Zr-95, Nb-95, Ru-106, Sb-125, Cs-134, Cs-137, Ce-144, Eu-154, Pu-241, Am-241 were also very low (between 1E-28 to 1E-307 pCi/l) and were not evaluated further for the ground water ingestion pathway. Only the radionuclides emitting gamma radiation were evaluated for the external exposure pathway. These radionuclides include Co-60, Cs-134, Cs-137, Eu-154, Np-237, U-234, U-235, U-236, Pu-239, Pu-240, Pu-242, and Am-241.

The lifetime intake values calculated for the future residential scenario for soil ingestion, fugitive dust, ground water ingestion, and external exposure pathways are summarized in Table 4-8.

4.2.3 Risk Characterization Summary

Cancer risks were calculated from the estimated lifetime intake values (Table 4-8) following the procedures described in Section 3. The calculated risks for the complete pathways are summarized in Table 4-9 by contaminant and exposure pathway. Based upon the depth of the contamination (i.e., greater than 9 feet bgs), the only potential exposure at this site is to a future residential receptor.

The cumulative risk from exposure to all radionuclides to a future residential receptor through the soil ingestion pathway is 1.0E+00. This high risk indicates that the health effects from exposure to site contaminants should be evaluated for acute effects, rather than for the chronic health hazards as currently being evaluated. The radionuclides contributing the most significant risks are Sr-90, Cs-137, Am-241, Pu-239, and Pu-240 (risks of 0.7E+00, 0.85E+00, 0.4E+00, 3.8E-03, and 3.6E-03, respectively). The risks from the other radionuclides are less than 1E-04.

The cumulative risk from exposure to all radionuclides from fugitive dust inhalation is 7.6E-04. Am-241 presents the most significant risk (7.1E-04), with the risk from Sr-90, Cs-137, Pu-239, and Pu-241 all being slightly less than 1E-04.

Nine radionuclides were evaluated under the ground water ingestion pathway resulting in a cumulative risk of 1.6E-04. Only the peak water concentrations for tritium, Pu-239 and Pu-240 had risk values (3.6E-05, 7.5E-05, and 4.5E-05, respectively) greater than 1E-06. The estimated travel time for the peak ground

Table 4-8. Lifetime Intake and Exposure Table for CPP-28

OU: 3-07 Site: CPP-28

Contaminant	Source SC (pCi/g or mg/kg)	Current Occupational Scenario			Future Residential Scenario						Future Recreational Scenario		
		Soil Ingestion	Inhalation of Fugitive Dust	External Exposure	Soil Ingestion	Inhalation of Fugitive Dust	Ground Water Ingestion			External Exposure	Soil Ingestion	Inhalation of Fugitive Dust	External Exposure
		Intake (pCi)	Intake (pCi)	(pCi-yr/g)	Intake (pCi)	Intake (pCi-yr/g)	Travel Time (years)	Half-life (years)	Intake (pCi)	(pCi-yr/g)	Intake (pCi)	Intake (pCi)	(pCi-yr/g)
Tritium (H-3)	2.5E+04	(3)	(3)	(3)	6.0E+06	7.2E+01	5.5E+01	1.2E+01	6.6E+08	1.3E+05	(3)	(3)	(3)
Cobalt-60	2.3E+04	(3)	(3)	(3)	5.7E+05	6.8E+00	3.1E+03	5.3E+00	3.8E-173	1.3E+04	(3)	(3)	(3)
Strontium-90	5.7E+07	(3)	(3)	(3)	3.5E+10	4.2E+05	9.7E+02	2.9E+01	5.8E-01	7.9E+08	(3)	(3)	(3)
Ruthenium-106	5.4E-01	(3)	(3)	(3)	7.7E-05	9.2E-10	5.5E+01	3.7E+02	4.1E-21	1.7E-06	(3)	(3)	(3)
Cesium-134	7.6E+04	(3)	(3)	(3)	4.1E+03	5.0E-02	1.5E+05	2.1E+00	3.5E-218	9.2E+01	(3)	(3)	(3)
Cesium-137	1.0E+08	(3)	(3)	(3)	6.7E+10	8.0E+05	1.5E+05	3.0E+01	3.0E-217	1.5E+09	(3)	(3)	(3)
Cerium-144	1.4E+01	(3)	(3)	(3)	4.6E-08	5.5E-13	1.5E+05	7.8E-01	1.8E-229	1.0E-09	(3)	(3)	(3)
Europium-154	5.7E+05	(3)	(3)	(3)	6.9E+07	8.3E+02	5.5E+01	8.6E+00	8.7E+05	1.5E+06	(3)	(3)	(3)
Neptunium-237	1.6E+00	(3)	(3)	(3)	2.1E+03	2.5E-02	6.8E+03	2.1E+06	5.2E+01	4.7E+01	(3)	(3)	(3)
Uranium-234	2.1E+01	(3)	(3)	(3)	2.8E+04	3.3E-01	1.9E+03	2.4E+05	2.5E+03	6.1E+02	(3)	(3)	(3)
Uranium-235	2.4E-01	(3)	(3)	(3)	3.1E+02	3.8E-03	1.9E+03	7.0E+08	2.7E+01	7.0E+00	(3)	(3)	(3)
Uranium-236	7.6E-01	(3)	(3)	(3)	9.8E+02	1.2E-02	1.9E+03	2.3E+07	8.8E+01	2.2E+01	(3)	(3)	(3)
Plutonium-239	1.3E+04	(3)	(3)	(3)	1.6E+07	2.0E+02	6.8E+03	2.4E+04	3.3E+05	3.7E+05	(3)	(3)	(3)
Plutonium-240	1.2E+04	(3)	(3)	(3)	1.6E+07	1.9E+02	6.8E+03	6.5E+03	1.9E+05	3.5E+05	(3)	(3)	(3)
Plutonium-241	1.1E+06	(3)	(3)	(3)	3.2E+08	3.9E+03	6.7E+03	1.4E+01	6.4E-135	7.2E+06	(3)	(3)	(3)

Table 4-8. Lifetime Intake and Exposure Table for CPP-28

OU: 3-07 Site: CPP-28

Contaminant	Source SC (pCi/g or mg/kg)	Current Occupational Scenario			Future Residential Scenario						Future Recreational Scenario		
		Soil Ingestion	Inhalation of Fugitive Dust	External Exposure	Soil Ingestion	Inhalation of Fugitive Dust	Ground Water Ingestion			External Exposure	Soil Ingestion	Inhalation of Fugitive Dust	External Exposure
		Intake (pCi)	Intake (pCi)	(pCi-yr/g)	Intake (pCi)	Intake (pCi-yr/g)	Travel Time (years)	Half-life (years)	Intake (pCi)	(pCi-yr/g)	Intake (pCi)	Intake (pCi)	(pCi-yr/g)
Americium-241	1.5E+06(1)	(3)	(3)	(3)	1.9E+09	2.2E+04	1.0E+05	4.3E+02	2.8E-66	4.1E+07	(3)	(3)	(3)
Plutonium-242	3.2E+01	(3)	(3)	(3)	4.2E+04	5.0E-01	6.8E+03	3.8E+05	1.0E+03	9.3E+02	(3)	(3)	(3)

SC = Soil Concentration (mg/kg for nonradiioactive; pCi/g for radioactive)

Note: Soil concentrations based upon calculated values and not from sample data (see text).

1 The 1974 soil concentration for Americium-241 was assumed to be equal to that of Plutonium-241, then adjusted for 18 years of radioactive decay. Since fission may have occurred prior to 1974, the soil concentration of Americium-241 may be greater than the estimated value, but is probably not greater than an order of magnitude.

2 No gamma emissions, pathway not complete.

3 Pathway not complete (no contamination in upper 4 feet).

Table 4-9. Risk Assessment Summary Table for CPP-28

OU: 3-07 Site: CPP-28

Contaminant	Source SC (pCi/g or mg/kg)	Current Occupational Scenario			Future Residential Scenario						Future Recreational Scenario		
		Soil Ingestion	Inhalation of Fugitive Dust	External Exposure	Soil Ingestion	Inhalation of Fugitive Dust	Ground Water Ingestion			External Exposure	Soil Ingestion	Inhalation of Fugitive Dust	External Exposure
		Cancer risk	Cancer risk	Cancer risk	Cancer risk	Cancer risk	Travel Time (years)	Half-life (years)	Cancer Risk	Cancer risk	Cancer risk	Cancer risk	Cancer risk
Tritium (H-3)	2.5E+04	(5)	(5)	(5)	3.2E-07	5.6E-12	5.5E+01	1.2E+01	3.6E-05	(3)	(5)	(5)	(5)
Cobalt-60	2.3E+04	(5)	(5)	(5)	8.5E-06	1.0E-09	3.1E+03	5.3E+00	5.7E-184	0.1E+00(1)	(5)	(5)	(5)
Strontium-90 +d	5.7E+07	(5)	(5)	(5)	0.7E+00(1)	2.4E-05	9.7E+02	2.9E+01	1.9E-11	(3)	(5)	(5)	(5)
Ruthenium-106	5.4E-01	(5)	(5)	(5)	7.3E-16	4.1E-19	5.5E+01	3.7E+02	3.7E-32	(3)	(5)	(5)	(5)
Cesium-134	7.6E+04	(5)	(5)	(5)	1.7E-07	1.4E-12	1.5E+05	2.1E+00	1.5E-228	4.8E-04	(5)	(5)	(5)
Cesium-137 +d	1.0E+08	(5)	(5)	(5)	2.85E+00(1)	1.5E-05	1.5E+05	3.0E+01	8.3E-228	1.0E+00(1)	(5)	(5)	(5)
Cerium-144	1.4E+01	(5)	(5)	(5)	2.8E-19	1.9E-22	1.5E+05	7.8E-01	1.1E-240	(3)	(5)	(5)	(5)
Europium-154	5.7E+05	(5)	(5)	(5)	2.1E-04	1.2E-07	5.5E+01	8.6E+00	2.6E-06	1.0E+00(1)	(5)	(5)	(5)
Neptunium-23 +d	1.6E+00	(5)	(5)	(5)	4.7E-07	7.4E-10	6.8E+03	2.1E+06	1.2E-08	2.0E-05	(5)	(5)	(5)
Uranium-234	2.1E+01	(5)	(5)	(5)	4.4E-07	8.6E-09	1.9E+03	2.4E+05	4.0E-08	1.8E-08	(5)	(5)	(5)
Uranium-235 +d	2.4E-01	(5)	(5)	(5)	5.0E-09	9.4E-11	1.9E+03	7.0E+08	4.4E-10	1.7E-06	(5)	(5)	(5)
Uranium-236	7.6E-01	(5)	(5)	(5)	1.5E-08	2.9E-10	1.9E+03	2.3E+07	1.3E-09	5.3E-10	(5)	(5)	(5)
Plutonium-239	1.3E+04	(5)	(5)	(5)	3.8E-03	7.5E-06	6.8E+03	2.4E+04	7.5E-05	6.2E-06	(5)	(5)	(5)
Plutonium-240	1.2E+04	(5)	(5)	(5)	3.6E-03	7.2E-06	6.8E+03	6.5E+03	4.5E-05	9.5E-06	(5)	(5)	(5)
Plutonium-241	1.1E+06	(5)	(5)	(5)	1.2E-03	8.9E-07	6.7E+03	1.4E+01	(4)	(3)	(5)	(5)	(5)

Table 4-9. Risk Assessment Summary Table for CPP-28

OU: 3-07 Site: CPP-28

Contaminant	Source SC (pCi/g or mg/kg)	Current Occupational Scenario			Future Residential Scenario						Future Recreational Scenario		
		Soil Ingestion	Inhalation of Fugitive Dust	External Exposure	Soil Ingestion	Inhalation of Fugitive Dust	Ground Water Ingestion			External Exposure	Soil Ingestion	Inhalation of Fugitive Dust	External Exposure
		Cancer risk	Cancer risk	Cancer risk	Cancer risk	Cancer risk	Travel Time (years)	Half-life (years)	Cancer Risk	Cancer risk	Cancer risk	Cancer risk	Cancer risk
Americium-241	1.5E+06(2)	(5)	(5)	(5)	0.4E+00(1)	7.1E-04	1.0E+05	4.3E+02	6.7E-76	0.2E+00(1)	(5)	(5)	(5)
Plutonium-242	3.2E+01	(5)	(5)	(5)	9.2E-06	1.8E-08	6.8E+03	3.8E+05	2.3E-07	2.1E-08	(5)	(5)	(5)
CUMULATIVE SUM					1.0E+00(1)	7.6E-04			1.6E-04	1.0E+00(1)			

SC = Soil Concentration (mg/kg for nonradioactive; pCi/g for radioactive)

Note: Soil concentrations based upon calculated values and not from sample data (see text).

+d Includes risk due to progeny.

1 Calculated risks using the multi-stage model were greater than 0.01. Risks shown were calculated using the one-hit model equation (Risk = $1-\exp^{(-CDI \times SF)}$) (US EPA 1989).

2 The 1974 soil concentration for Americium-241 was assumed to be equal to that of Plutonium-241, then adjusted for 18 years of radioactive decay. Since fission may have occurred for longer than 18 years, the soil concentration of Americium-241 may be greater than the estimated value, but the actual value is probably not greater than an order of magnitude.

3 No gamma emissions, pathway not complete.

4 The calculated soil or water concentrations and resultant intake values were extremely small and unrealistic - no risk calculated.

5 Pathway not complete (no contamination in upper 4 feet).

water concentration to occur in the aquifer for the plutonium isotopes is 6,800 years in the future.

The risk calculated for the future residential scenario from external exposure to all the radionuclides detected is 1E+00. This high risk indicates that the health effects from exposure to site contaminants should be evaluated for acute effects, rather than for the chronic health hazards as currently being evaluated. The major contributors to the risk are europium-154 and cesium-137. The cancer risk for exposure to these radionuclides was calculated using the one-hit dose-response model because of the high estimated lifetime exposure from this soil concentration. The risk from the other ten radionuclides evaluated ranged from 2.0E-01 to 5.3E-10.

4.2.4 Uncertainty Discussion

The nature and extent of contamination at this site is based upon a well documented characterization effort implemented following the discovery of the release and process knowledge of the waste stream. No physical sample data is available to definitively determine the contaminants of concern and the resultant concentration for this site due to health and safety and the physical constraints described in the SAP.

The vast majority of the uncertainty associated with this site is from the characterization data. The overall reliability of the site characterization information is low to moderate. The primary areas of uncertainty include:

- The actual volume of the release is unknown. The estimate of 120 gallons containing approximately 6000 curies of gross radioactively was based on several assumptions including the concentration of the typical waste solution of 50 curies/gallon and the total residual activity in the soil based on a possibly biased analyses from several D-D containers.

- The original isotopic composition of the release is unknown. The soil concentration is based upon the average percent distribution of the various radionuclides in the first-cycle raffinate according to measurements taken on September 15, 1971 from the waste in the underground storage tanks.

- The 1992 soil concentrations are estimated as if the release of first-cycle raffinate waste occurred as a single event in 1974 rather than slowly during a period from 1955 through 1974. This will likely result in a higher estimate of the soil concentrations since an additional 19 years of radioactive decay is not included in the calculations.

A summary of the primary uncertainty related to the risk calculations is provided in Table 4-10. The overall uncertainty has a moderate to high potential to either over- or underestimate the risk.

Table 4-10: Uncertainty Assessment for Site CPP-28

Assumption	Effect on Exposure[1]		
	Potential Magnitude for Over-Estimation of Exposure	Potential Magnitude for Under-Estimation of Exposure	Potential Magnitude for Over- or Under-Estimation of Exposure
Environmental Sampling and Analysis			
The estimated present day soil concentrations and potential contaminants are based upon process knowledge and calculations.			High
Extent of contamination based upon characterization of the site following the incident and not later sample data.			Moderate to High
Exposure Parameter Estimation			
The standard assumptions regarding body weight, period exposed, life expectancy, population characteristics, and lifestyle may not be representative of any actual exposure situation.	Moderate		
The amount of media intake is assumed to be constant and representative of the population.	Moderate to High		
Assumption of daily lifetime exposure to residents.	Moderate to High		

[1]As a general guideline, assumptions marked as "low" may affect estimates of exposure by less than one order of magnitude; assumptions marked "moderate" may affect estimates of exposure by between one and two orders of magnitude; and assumptions marked "high" may affect estimates of exposure by more than two orders of magnitude (EPA 1989).

4.2.5 Human Health Assessment

No adverse health effects were calculated for potential receptors under the current occupational or future recreational scenarios because the depth of contamination (approximately 9 to 11 feet bgs) is below the target depths for both of these scenarios. Additionally, all ICPP workers are closely supervised to minimize exposures, and radiation levels within the Tank Farm are monitored by the WINCO Environmental Safety and Health Department.

Risks greater than 1E-04 are associated with all exposure pathways for the future residential scenario. The cumulative risks for soil ingestion, fugitive dust inhalation, ground water ingestion, and external exposure are 1.0E+00, 7.6E-04, 1.6E-04, and 1.0E+00, respectively. The estimation of risk is based on the assumption that a residential receptor will be at the site in 30 years and no cleanup of the site has occurred. These risks are then calculated using the maximum, or if sufficient data is available, the upper 95% confidence limit concentration from the samples collected in the upper 10 feet. The risks are then calculated assuming that a future residential receptor is subjected to the contamination for an exposure duration of 24 hours/day, 350 days/year for 30 years.

4.3 CPP-31 (Contaminated Soil South of Tank WM-183)

The release at this site was discovered on September 18, 1975 during the drilling of an "observation well" (A-53) located approximately 15 feet west of tank WM-183 centerline and about 10 feet south of the edge of the tank vault. Radiation readings of the contaminated soil brought to the surface from this location ranged from 100 mr/hr at a depth of 15 feet to 500 mr/hr at a depth of 22 feet. This release was further investigated by additional exploratory drilling of the area. The findings of this investigation are documented in the *Investigation Report for the ICPP Contaminated Soil Incident Dated September 18, 1975*. At the time of the incident, it was concluded that approximately 600-800 yd^3 of soil were contaminated by an estimated 14,000 gallons of HLLW that contained 28,000 curies of fission products (primarily Cs-137, Sr-90, and Y-90).

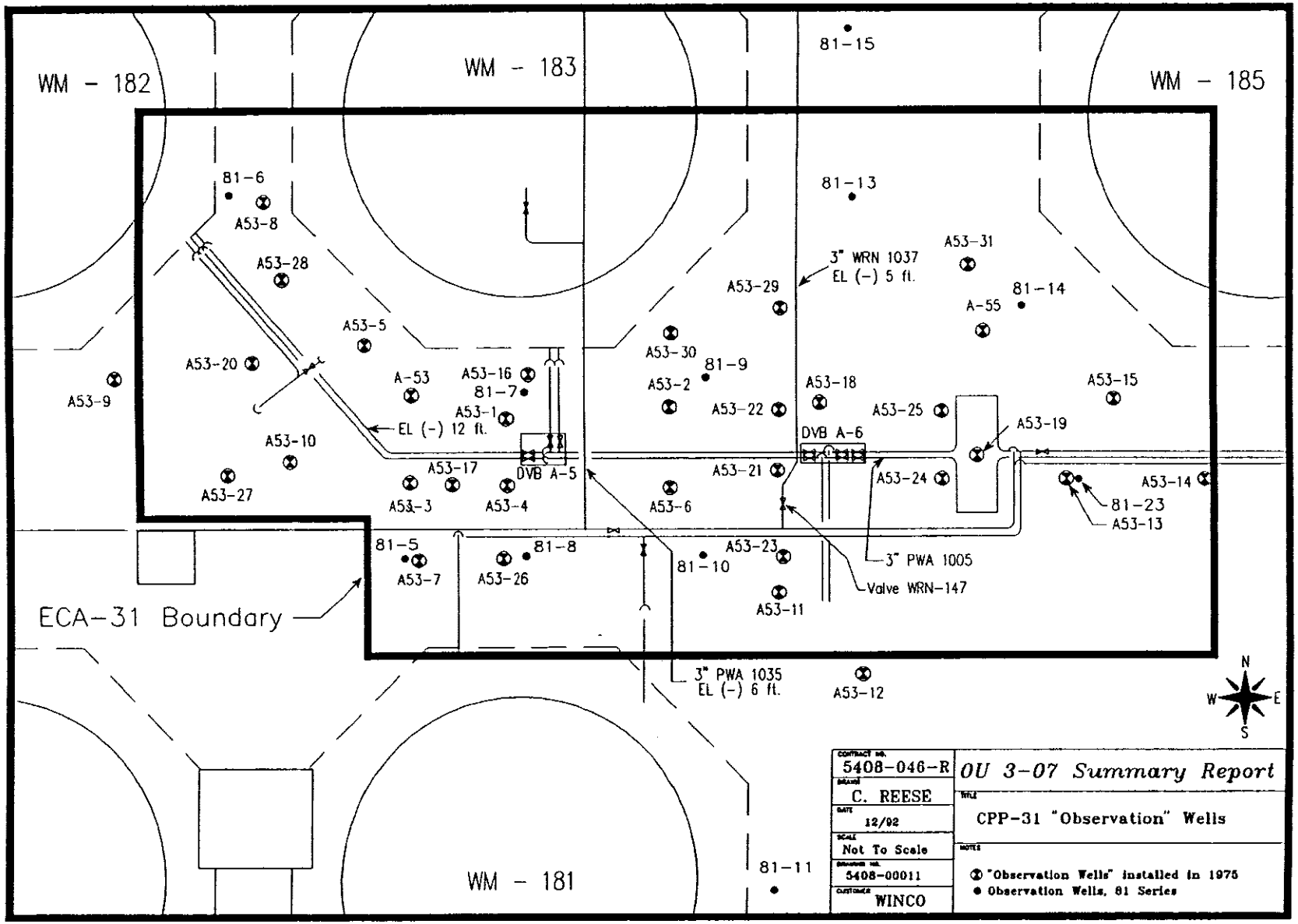
4.3.1 Nature and Extent of Contamination.

In 1975, 33 "observation wells" were installed to investigate the release from this site. The locations of these "observation wells", designated as A53 through A53-31 and A-55, are shown in Figure 4-6. The chronology for the installation of the "observation wells" are as follows:

- Sixteen "observation wells" (A53 through A53-15) were installed in September - October 1975.
- Five "observation wells" (A53-16 through A53-20) were installed in November 1975.
- Eleven "observation wells" (A53-17 through A53-31 and A55) were installed in December 1975.

Following installation, direct radiation readings were obtained from these "observation wells" by lowering a string of TLD chips down the pipe and exposing

Figure 4-6. Locations of the "Observation Wells" at Site CPP-31.



them for a period of one hour. The results of these measurement taken in 1975 are presented in Table 4-11.

The extent of the contaminated soil was estimated in 1975 using the results of direct radiation scans of holes drilled in the immediate area. The vertical profile of the contamination was considered to have been somewhat disturbed due to the auger drill used. Activity near the top of the holes was considered to be primarily activity augered up from the main pocket of activity at a depth of 12 to 25 feet. Likewise, higher levels of activity at the bottom of the hole were considered to be the result of drill bit contamination and contaminated soil falling into the hole from highly contaminated regions. The subsurface radiation profiles (Table 4-11) were then used to establish two isopleths of the contaminated soil: one isopleth having radiation levels greater than 10 rem/hr and one isopleth having radiation levels greater than 1 rem/hr to estimate the volume of contamination (Figure 4-7). The estimated volume of the contaminated soil is approximately 200 cubic yards in the 10 rem/hr range and 400 cubic yards in the 1 rem/hr range, making a net total of approximately 600 cubic yards of contaminated soil at this site.

One soil sample from each borehole was collected in 1975 and analyzed for radionuclides (Table 4-12). The soil samples were collected from the soil that was brought to the surface from around the auger flights. As a result of the sample collection, considerable mixing of the contaminated soil with the surrounding uncontaminated soil probably occurred and the results in Table 4-12 are representative only of the general type of contamination present. Based on radioactive decay from the 1975 concentrations, the 1992 soil concentrations were also calculated as shown in Table 4-12.

In the early 1980's several additional "observation wells" were installed in the tank farm area to monitor the subsurface radiation levels. The location of these "observation wells", designated as the 81-series, are shown in Figure 4-6. At the time of this report, no information is available concerning the construction details for these "observation wells".

On August 18, 1992, subsurface radiation profile surveys were performed on selected "observation wells" as part of the Track 2 investigation. The radiation profiles were performed in ten "observation wells" with the results provided in Table 4-13. A comparison of these results to previous subsurface radiation profile measurements is inconclusive as to whether migration has occurred since the time of the release or if the radiation levels in the soil are increasing or decreasing over time.

4.3.1.1 Nature and Extent Conclusions. Based upon the characterization effort following the discovery of the release, the following is known about the soil contamination at site CPP-31:

- The greatest concentrations of radionuclides were detected at depths from 13-15 feet bls and 17-19 feet bls.

- The majority of the contamination is located adjacent to the waste line encasements between valve box A-6 and valve box A-5, between valve box A-5 and the vault for tank WM-183, and between valve box A-5 and the vault for tank WM-182. Lower levels of contamination are also located along the encasement between valve box A-6 and valve box B-3.

Table 4-11. Direct Radiation Measurements in 1975 from the "Observation Wells" Installed at Site CPP-31 following the Release.

Depth ft	"Observation Well" (All measurement in R/hr)															
	A53	A53-1	A53-2	A53-3	A53-4	A53-5	A53-6	A53-7	A53-8	A53-9	A53-10	A53-11	A53-12	A53-13	A53-14	A53-15
1	1.0	1.0	0.3	0.5	0.2	0.015	0.4	0.02	0.01	0.01	1.0	0.01	0.01	0.3	0.007	0.55
2	--	--	--	0.6	0.2	0.01	0.35	0.01	0.01	--	1.5	--	--	--	--	0.61
3	--	--	--	0.65	0.35	0.04	0.4	0.01	--	--	1.5	--	--	--	--	0.45
4	--	--	--	0.6	0.4	0.07	0.4	0.01	--	--	1.5	--	--	--	--	0.5
5	1.5	2.0	0.25	0.6	0.5	0.2	0.45	0.05	0.01	0.01	1.5	0.085	0.02	0.5	0.003	0.5
6	--	--	--	--	1.0	0.5	0.5	0.02	--	--	1.5	--	--	--	--	0.6
7	--	--	--	0.65	1.3	1.6	0.55	0.02	--	--	1.5	--	--	--	--	0.35
8	--	2.0	--	0.6	1.0	2.5	0.55	0.01	--	--	1.5	--	--	--	--	0.3
9	--	3.0	--	0.6	1.8	4.0	0.55	0.01	--	--	1.5	--	--	--	--	0.2
10	2.0	2.5	0.45	0.5	1.1	3.5	0.7	0.01	0.005	0.01	1.5	0.01	0.015	0.55	0.005	0.2
11	--	3.0	0.5	0.6	2.0	4.0	0.8	0.01	--	--	--	--	--	--	--	0.2
12	--	3.0	1.5	0.6	2.5	5.0	0.9	0.01	--	--	2.0	--	--	--	--	0.2
13	2.0	>10.0	>10.0	2.0	4.0	5.0	>10.0	0.01	--	--	2.0	--	--	--	--	0.15
14	>10.0	8.0	1.5	7.0	3.5	7.0	>10.0	0.005	--	--	>10.0	--	--	0.9	0.01	0.2
15	3.0	1.5	0.1	0.6	2.0	4.5	0.35	0.006	0.005	0.003	>10.0	0.005	0.01	3.0	0.005	0.3
16	3.0	2.0	--	0.45	3.0	5.5	0.1	0.004	--	--	4.0	--	--	0.5	0.006	5.0
17	10.0	>10.0	--	0.85	8.5	9.0	0.1	0.003	--	--	2.0	--	--	0.5	--	4.0
18	>10.0	>10.0	--	9.0	>10.0	>10.0	0.1	0.002	--	--	10.0	--	--	--	--	0.2
19	>10.0	5.0	--	1.4	3.0	>10.0	0.05	0.003	--	--	0.6	--	--	--	--	0.1
20	2.5	0.2	0.01	1.1	2.5	8.5	0.05	0.008	0.003	0.006	0.35	0.006	0.006	0.035	0.003	0.05
21	2.5	--	--	--	0.7	10.0	0.05	0.004	--	--	0.2	--	--	--	--	0.01
22	5.0	--	--	--	--	6.0	0.02	0.004	--	--	0.1	--	--	--	--	0.01
23	>10.0	--	--	0.15	--	1.0	0.025	0.005	--	--	0.1	--	--	--	--	0.01
24	6.0	--	--	--	--	0.15	0.03	0.01	--	--	0.1	--	--	0.015	--	0.01
25	0.3	0.2	0.08	0.25	2.0	1.0	0.04									

Table 4-11. Direct Radiation Measurements in 1975 from the "Observation Wells" Installed at Site CPP-31 following the Release.

Depth (ft)	"Observation Well" (All Measurements in R/hr)															
	A53-16	A53-17	A53-18	A53-19	A53-20	A53-21	A53-22	A53-23	A53-24	A53-25	A53-26	A53-27	A53-28	A53-29	A53-30	A53-31
1	<0.001	<0.001	<0.001	<0.001	<0.001	--	--	Bkg	0.02	Bkg	0.02	0.015	Bkg	Bkg	--	Bkg
2	<0.001	<0.001	<0.001	<0.001	<0.001	1.0	0.05	Bkg	4.06	0.04	0.02	Bkg	Bkg	Bkg	--	Bkg
3	<0.001	<0.001	0.02	<0.001	<0.001	9.8	0.06	Bkg	Bkg	0.03	0.03	0.02	Bkg	0.035	Bkg	Bkg
4	<0.001	<0.001	1.3	<0.001	<0.001	23.7	1.79	Bkg	3.9	0.18	Bkg	Bkg	Bkg	2.03	Bkg	Bkg
5	<0.001	<0.001	0.1	<0.001	<0.001	41.8	6.29	Bkg	Bkg	0.03	Bkg	Bkg	Bkg	Bkg	Bkg	Bkg
6	<0.001	<0.001	0.1	<0.001	<0.001	50.2	3.13	Bkg	0.020	0.04	0.02	0.04	Bkg	0.03	0.01	Bkg
7	<0.001	<0.001	0.1	<0.001	<0.001	49.2	0.38	Bkg	0.020	0.02	0.03	Bkg	Bkg	Bkg	0.06	Bkg
8	<0.001	<0.001	0.2	<0.001	<0.001	46.1	0.13	Bkg	0.010	0.04	0.03	Bkg	Bkg	0.2	0.01	Bkg
9	<0.001	<0.001	3.4	0.002	<0.001	49.2	0.18	Bkg	0.060	0.04	pipe broke	Bkg	Bkg	7.5	Bkg	Bkg
10	<0.001	0.002	2.8	0.005	<0.001	40.0	--	Bkg	0.020	0.19	in	Bkg	Bkg	1.6	Bkg	Bkg
11	<0.001	0.006	0.34	0.1	<0.001	24.8	--	Bkg	0.030	0.47	coupling	Bkg	Bkg	0.2	0.08	Bkg
12	0.03	0.04	0.27	0.15	0.004	27.8	--	Bkg	0.260	2.0	--	Bkg	Bkg	4.0	0.60	Bkg
13	1.1	1.78	3.1	1.9	0.22	27.3	--	Bkg	4.9	2.6	--	Bkg	Bkg	1.5	0.10	Bkg
14	11.6	8.2	8.8	16.0	7.3	26.9	--	Bkg	14.9	33.9	--	6.6	Bkg	--	0.04	Bkg
15	15.1	15.2	1.76	28.0	9.8	22.6	--	Bkg	16.2	40.1	--	--	Bkg	--	--	Bkg
16	2.4	23.5	5.4	23.0	6.8	10.3	--	Bkg	20.2	43.2	--	--	0.07	--	--	Bkg
17	1.9	6.8	0.25	13.0	16.4	12.3	--	Bkg	3.8	34.5	--	--	0.8	--	--	Bkg
18	8.6	19.9	0.04	3.4	1.57	1.16	--	Bkg	1.6	36.6	--	--	5.8	--	--	Bkg
19	12.6	2.1	0.03	2.3	0.16	0.61	--	Bkg	1.6	--	--	--	--	--	--	Bkg
20	0.6	3.3	0.04	4.0	0.7	--	--	Bkg	--	--	--	--	--	--	--	Bkg
											--					

Bkg = Background

Figure 4-7. 1975 Isopleths of the Contaminated Soil at Site CPP-31.
(Reproduced from the best available copy)

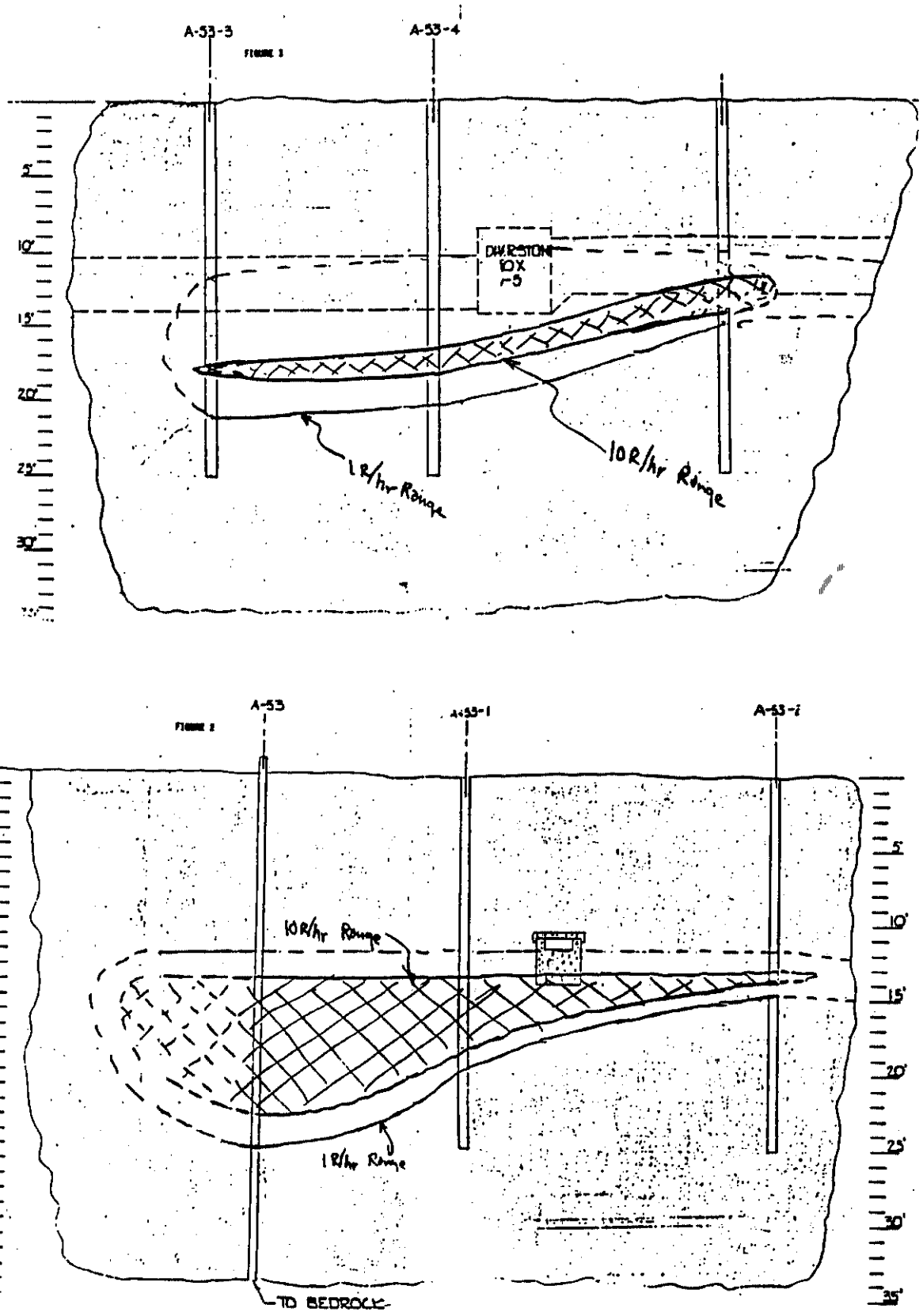


Table 4-12. Results of the 1975 Radiological Analyses of the Soil and the Calculated 1992 Concentrations based on Radioactive Decay

Sample	Soil Concentrations (pCi/g)[1]									
	Co-60		Sr-90		Sr-95		Ru-106		Cs-134	
	1975	1992	1975	1992	1975	1992	1975	1992	1975	1992
A 53	3.16E+3	3.36E+2	2.51E+5	1.65E+5	NA	NA	NA	NA	7.24E+3	2.40E+1
A 53-1	4.54E+2	4.83E+1	NA	NA	NA	NA	NA	NA	6.86E+3	2.28E+1
A 53-2	2.62E+2	2.79E+1	3.11E+5	2.04E+5	NA	NA	NA	NA	7.11E+2	2.36E+0
A 53-3	3.54E+2	3.76E+1	NA	NA	4.62E+2	0.00E+0	NA	NA	1.10E+3	3.65E+0
A 53-4	2.30E+2	2.45E+1	4.16E+5	2.73E+5	NA	NA	NA	NA	4.03E+2	1.34E+0
A 53-5	8.78E+2	9.34E+1	NA	NA	NA	NA	NA	NA	5.40E+3	1.79E+1
A 53-6	4.65E+2	4.94E+1	NA	NA	NA	NA	NA	NA	1.08E+3	3.58E+0
A 53-8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A 53-9	3.13E+2	3.33E+1	NA	NA	NA	NA	7.97E+3	6.66E-2	NA	NA
A 53-10	5.51E+2	5.86E+1	1.08E+6	7.10E+5	NA	NA	NA	NA	3.24E+3	1.07E+1
A 53-11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A 53-12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A 53-13	NA	NA	NA	NA	NA	NA	NA	NA	2.97E+2	9.85E-1
A 53-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A 53-15	3.38E+2	3.59E+1	NA	NA	9.48E+2	0.00E+0	NA	NA	2.49E+3	8.26E+0
A 55	3.97E+2	4.22E+1	4.16E+5	2.73E+5	NA	NA	NA	NA	5.24E+2	1.74E+0
Average	6.73E+2	7.16E+1	4.95E+5	3.25E+5	7.05E+2	0.00E+0	7.97E+3	6.66E-2	2.67E+3	8.85E+0
ST DEV	8.44E+2	8.97E+1	3.35E+5	2.20E+5	3.44E+2	0.00E+0			2.65E+3	8.80E+0
95% CI	1.13E+3	1.21E+2	8.14E+5	5.35E+5	2.24E+3	0.00E+0			4.12E+3	1.37E+1

Note: 1. These values were originally reported in dps/g and have been converted accordingly using 1Ci = 3.7E10 dps, and have also been decayed from 1975 to 1992 according to each radionuclide's half life.

Table 4-12. Results of the 1975 Radiological Analyses of the Soil and the Calculated 1992 Concentrations based on Radioactive Decay

Sample	Soil Concentrations (pCi/g)[1]							
	Cs-137		Eu-154		U-235		Pu-239, 240	
	1975	1992	1975	1992	1975	1992	1975	1992
A 53	3.24E+6	2.19E+6	3.21E+3	8.41E+2	9.0E+3	9.0E+3	1.50E+3	1.50E+3
A 53-1	3.05E+6	2.06E+6	1.05E+4	2.75E+3	NA	NA	NA	NA
A 53-2	2.30E+5	1.56E+5	8.81E+2	2.31E+2	5.49E+2	5.49E+2	9.46E+1	9.46E+1
A 53-3	5.97E+5	4.04E+5	4.62E+3	1.21E+3	NA	NA	NA	NA
A 53-4	1.80E+5	1.22E+5	9.54E+2	2.50E+2	6.21E+2	6.21E+2	1.05E+2	1.05E+2
A 53-5	2.41E+6	1.63E+6	6.08E+3	1.59E+3	NA	NA	NA	NA
A 53-6	4.78E+5	3.24E+5	2.29E+3	6.00E+2	NA	NA	NA	NA
A 53-8	6.76E+3	4.58E+3	NA	NA	NA	NA	NA	NA
A 53-9	1.75E+3	1.18E+3	NA	NA	NA	NA	NA	NA
A 53-10	1.62E+6	1.10E+6	6.78E+3	1.78E+3	3.65E+3	3.65E+3	6.19E+2	6.19E+2
A 53-11	8.11E+3	5.49E+3	NA	NA	NA	NA	NA	NA
A 53-12	3.11E+3	2.10E+3	NA	NA	NA	NA	NA	NA
A 53-13	1.34E+5	9.07E+4	7.32E+2	1.92E+2	NA	NA	NA	NA
A 53-14	2.88E+3	1.95E+3	NA	NA	NA	NA	NA	NA
A 53-15	1.09E+6	7.38E+5	5.48E+3	1.44E+3	NA	NA	NA	NA
A 55	2.95E+5	2.00E+5	8.19E+2	2.15E+2	8.16E+2	8.16E+2	1.34E+2	1.34E+2
Average	8.34E+5	5.65E+5	3.85E+3	1.01E+3	2.93E+3	2.93E+3	4.90E+2	4.90E+2
ST DEV	1.13E+6	7.63E+5	3.16E+3	8.28E+2	3.63E+3	3.63E+3	6.06E+2	6.06E+2
95% CI	1.33E+6	8.99E+5	1.46E+3	1.46E+3	6.39E+3	6.39E+3	1.07E+3	1.07E+3

Note: 1. These values were originally reported in dps/g and have been converted accordingly using 1Ci = 3.7E10 dps, and have also been decayed from 1975 to 1992 according to each radionuclide's half life.

Table 4-13. Summary of the Subsurface Radiation Profile Performed at Site CPP-31 on August 18, 1992.

SUMMARY OF RADIATION PROFILE SURVEYS							
Observation Well No:	A53-11	A53-19	81-6	81-7	81-9	81-13	81-14
Well Depth (ft)	Date: 8-18-92 By: Instr: Pipe is 12" above land surface.	Date: 8-18-92 By: Instr: Pipe is 18" above land surface.	Date: 8-18-92 By: Instr: Pipe is 20" above land surface.	Date: 8-18-92 By: Instr: Pipe is 8" above land surface	Date: 8-19-92 By: Instr: Pipe is 21" above land surface	Date:8-18-92 By: Instr: Pipe is 30" above land surface	Date:8-18-92 By: Instr: Pipe is 23" above land surface
			Exposure Rate (mR/hr)				
Ground Level							
2	100	100	100	100	100	100	0
4	100	100	100	100	100	100	100
6	100	100	100	100	100	0	100
8	100	100	100	100	100	200	0
10	200	100	100	100	100	7400	100
12	100	100	100	100	1200	200	100
14	100	200	100	100	200	100	100
16	100	13100	100	300	1100	100	100
18	100	22300	100	600	100	100	9300
20	100	9000	100	100	100	100	100
22	100		100	8400	100		100
24		Probe	100	8800	0		100
26		stopped at	100		100		0
28		20'. No 22' &	100	wet at	100	Wet at	0
30		24' readings	200	bottom		bottom	0
32							
34	restricted						
36	entry at		NOTE: >1500	NOTE: >2000			
38	top		at 29 feet	at 23 feet			
40							
42							
44							
46							
48							
50							
52							
54							
56							
58							
60							

Note: Used 0-200 R meter. The readings "0" and "100" mr/hr are essentially background.

Table 4-13 (cont.). Summary of the subsurface radiation profile performed at site CPP-31 on August 18, 1992.

SUMMARY OF RADIATION PROFILE SURVEYS							
"Observation Well" No:	81-3	81-10	81-8				
Well Depth (ft)	Date: 8-18-92 By: Instr: Pipe is 20" above land surface	Date: 8-18-92 By: Instr: Pipe is 26" above land surface	Date: 8-18-92 By: Instr: Pipe is 24" above land surface	Date: By: Instr:	Date: By: Instr:	Date: By: Instr:	Date: By: Instr:
			Exposure Rate (mR/hr)				
Ground Level							
2	0	0	100				
4	0	0	100				
6	0	0	100				
8	0	0	100				
10	0	0	0				
12	0	0	100				
14	0	0	100				
16	0	0	100				
18	500	0	0				
20	100	0	100				
22		0	100				
24	NOTE: >200 at	0	100				
26	19 feet	0	100				
28		0	100				
30		0					
32							
34							
36							
38							
40							
42							
44							
46							
48							
50							
52							
54							
56							
58							
60							

Note: Used 0-200 R meter. The readings "0" and 100 mr/hr are essentially background.

- The volume of highly contaminated soil was estimated to be at least 600 cubic yards in 1975.

- More than 99% of the gamma activity in the soil is due to the presence of Cs-137.

4.3.2 Quantification of Exposure

The potential risk at this site is from exposure to radionuclides. From the 1975 soil analyses, the contaminants of concern at this site are the following: Co-60, Sr-90, Sr-95, Ru-106, Cs-134, Cs-137, Eu-154, U-235, Pu-239, and Pu-240. The calculated present day soil concentrations shown, in Table 4-12, were adjusted for 17 years of radioactive decay (1975 to 1992). Sr-95, a fission product, has a half life of 25.1 seconds and was not evaluated further. The concentration for the remaining nine radionuclides are above the background concentration described in Table 3-1.

Under the current occupational and future recreational scenarios, both the inhalation of fugitive dust and soil ingestion pathways are not complete because the contamination is below the tank farm membrane (i.e., deeper than 6 inches). Therefore, lifetime intake values were only calculated for the external exposure pathway for both of these scenarios (Table 4-14). Due to radioactive decay, the calculated soil concentrations and associated intake values of Ru-106 and Cs-134 for the year 2092 are very small and were not evaluated further under the future residential and future recreational scenarios.

All exposure pathways evaluated for the future residential scenario are complete. The intake from seven radionuclides (Co-60, Sr-90, Cs-137, Eu-154, U-235, Pu-239, and Pu-240) were calculated for soil ingestion, fugitive dust inhalation, ground water ingestion, and external exposure (Table 4-14).

The GWSCREEN model predicted maximum peak water concentrations for Co-60 and Cs-137 of 2.2E-179 pCi/l and 1.1E-215 pCi/l, respectively. These two radionuclides were not evaluated further for the ground water pathway. The remaining five radionuclides that were evaluated in the ground water pathway to potential future residential receptors are Sr-90, Eu-154, U-235, Pu-239 and Pu-240.

4.3.3 Risk Characterization Summary

Cancer risks, calculated from the estimated lifetime intake values, are summarized in Table 4-14 by scenario and exposure pathway.

Given the depth to contamination, the only complete pathway for the current occupational scenario is from external exposure. The cumulative risk for this pathway is 1.0E+00, primarily related to exposure from Cs-137 at a soil concentration of 90,000 pCi/g. Other radionuclides evaluated (Co-60, Cs-134, Eu-154, and U-235) also result in risks greater than 1E-04 for this scenario and pathway.

Table 4-14. Lifetime Intake and Exposure Table for site CPP-31

OU: 3-07 Site: CPP-31

Contaminant	Source SC (pCi/g or mg/kg)	Current Occupational Scenario			Future Residential Scenario						Future Recreational Scenario		
		Soil Ingestion	Inhalation of Fugitive Dust	External Exposure	Soil Ingestion	Inhalation of Fugitive Dust	Ground Water Ingestion			External Exposure	Soil Ingestion	Inhalation of Fugitive Dust	External Exposure
		Intake (pCi)	Intake (pCi)	(pCi-yr/g)	Intake (pCi)	Intake (pCi-yr/g)	Travel Time (years)	Half-life (years)	Intake (pCi)	(pCi-yr/g)	Intake (pCi)	Intake (pCi)	(pCi-yr/g)
Cobalt-60	1.2E+02	(1)	(1)	6.9E+02	3.0E+03	1.8E-01	3.1E+03	5.3E+00	1.2E-172	6.7E+01	(1)	(1)	6.3E-02
Strontium-90	5.4E+05	(1)	(1)	(2)	3.3E+08	2.0E+04	9.7E+02	2.9E+01	5.3E-01	(2)	(1)	(1)	(2)
Ruthenium-106	6.7E-02	(1)	(1)	3.8E-01	9.5E+08	5.8E-12	5.5E+01	1.0E+00	2.5E-22	2.1E-09	(1)	(1)	2.0E-12
Cesium-134	1.4E+01	(1)	(1)	7.8E+01	7.5E-01	4.6E-05	1.5E+05	2.1E+00	8.9E-222	1.7E-02	(1)	(1)	1.6E-05
Cesium-137	9.0E+05	(1)	(1)	5.1E+06	5.9E+08	3.6E+04	1.5E+05	3.0E+01	1.2E-211	1.3E+07	(1)	(1)	1.2E+04
Europium-154	1.5E+03	(1)	(1)	8.3E+03	1.8E+05	1.1E+01	5.5E+01	8.6E+00	2.6E+05	4.0E+03	(1)	(1)	3.7E+00
Uranium-235	6.4E+03	(1)	(1)	3.6E+04	8.3E+06	5.1E+02	1.9E+03	7.0E+08	3.8E+07	1.9E+05	(1)	(1)	1.7E+02
Plutonium-239	1.1E+03	(1)	(1)	6.1E+03	1.4E+06	8.5E+01	6.8E+03	2.4E+04	1.4E+06	3.1E+04	(1)	(1)	2.9E+01
Plutonium-240	1.1E+03	(1)	(1)	6.1E+03	1.4E+06	8.5E+01	6.8E+03	6.5E+03	8.6E+05	3.1E+04	(1)	(1)	2.9E+01

SC = Soil concentration (mg/kg for nonradioactive, pCi/g for radioactive).
Note: Soil concentrations based on the upper 95% confidence limit from the 1975 analyses decayed to 1992 (see text).
1 Pathway not complete (no contamination detected in upper 6 inches).
2 No gamma emissions, pathway not complete.

Table 4-15. Risk Assessment Summary Table for site CPP-31

OU: 3-07 Site: CPP-31

Contaminant	Source SC (pCi/g or mg/kg)	Current Occupational Scenario			Future Residential Scenario						Future Recreational Scenario		
		Soil Ingestion	Inhalation of Fugitive Dust	External Exposure	Soil Ingestion	Inhalation of Fugitive Dust	Ground Water Ingestion			External Exposure	Soil Ingestion	Inhalation of Fugitive Dust	External Exposure
		Cancer risk	Cancer risk	Cancer risk	Cancer risk	Cancer risk	Travel Time (years)	Half-life (years)	Cancer risk	Cancer risk	Cancer risk	Cancer risk	Cancer risk
Cobalt-60	1.2E+02	(1)	(1)	5.9E-03	4.5E-08	2.8E-11	3.1E+03	5.3E+00	1.8E-183	5.8E-04	(1)	(1)	5.4E-07
Strontium-90	5.4E+05	(1)	(1)	(2)	1.1E-02(3)	1.1E-06	9.7E+02	2.9E+01	1.7E-11	(2)	(1)	(1)	(2)
Ruthenium-106+d	6.7E-02	(1)	(1)	(2)	9.0E-19	2.5E-21	5.5E+01	1.0E+00	2.4E-33	(2)	(1)	(1)	(2)
Cesium-134	1.4E+01	(1)	(1)	4.1E-04	3.1E-11	1.3E-15	1.5E+05	2.1E+00	3.6E-232	8.7E-08	(1)	(1)	8.1E-11
Cesium-137+d	9.0E+05	(1)	(1)	1.0E+00(3)	1.6E-02(3)	6.8E-07	1.5E+05	3.0E+01	3.2E-222	2.3E-01(3)	(1)	(1)	2.4E-02(3)
Europium-154	1.5E+03	(1)	(1)	3.4E-02	5.4E-07	1.5E-09	5.5E+01	8.6E+00	7.7E-07	1.6E-02(3)	(1)	(1)	1.5E-05
Uranium-235	6.4E+03	(1)	(1)	8.7E-03	1.3E-04	1.3E-05	1.9E+03	7.0E+08	6.0E-04	4.4E-02(3)	(1)	(1)	4.1E-05
Plutonium-239	1.1E+03	(1)	(1)	1.0E-07	3.2E-04	3.2E-06	6.8E+03	2.4E+04	3.3E-04	5.3E-07	(1)	(1)	4.9E-10
Plutonium-240	1.1E+03	(1)	(1)	1.6E-07	3.2E-04	3.2E-06	6.8E+03	6.5E+03	2.0E-04	8.4E-07	(1)	(1)	7.8E-10
CUMULATIVE SUM				1.0E+00(3)	2.8E-02(3)	2.1E-05			5.3E-04	2.3E-01(3)			2.4E-02(3)

SC = Soil concentration (mg/kg for nonradioactive; pCi/g for radioactive).
Note: Soil concentrations based on the upper 95% confidence limit from the 1975 analyses decayed to 1992 (see text).
+d Includes risk due to progeny.
1 Pathway not complete (no contamination detected in upper 6 inches).
2 No gamma emissions, pathway not complete.
3 Calculated risks using the multi-stage model were greater than 0.01. Risks shown were calculated using the one-hit model equation (Risk = $1-\exp^{(-CDI \times SF)}$). US EPA 1989.

The only complete pathway for the future recreational scenario is external exposure. The cumulative risk for this pathway is 2.4E-02, with the risk due to the presence of Cs-137 at a concentration of 90,000 pCi/g. The risk from all other radionuclides, except U-235, is less than 1E-06. The risk from U-235 is 4.1E-05.

All exposure pathways are complete for the future residential scenario projected to begin in 30 years (i.e., year 2022). The cumulative risks for soil ingestion, inhalation of fugitive dust, ground water ingestion, and external exposure pathways are 2.8E-02, 2.1E-05, 5.3E-04, and 2.3E-01 respectively. The cumulative cancer risk for the external exposure pathway is due primarily to the risk of 2.3E-01 for cesium-137 calculated using the one-hit dose-response model (U.S. EPA, 1989). This indicates a high probability of carcinogenicity for a receptor exposed per this scenario and pathway assumptions. The primary risk drivers are Sr-90 and Cs-137 for the soil ingestion pathway, Cs-137 for the external exposure pathway, and Pu-239 for the ground water ingestion pathway. For the ground water pathway however, the time to peak water concentration is 6800 years from the present.

4.3.4 Uncertainty Discussion

The nature and extent of contamination at this site is based upon a well documented characterization effort that was implemented following the discovery of the release. This characterization effort is further supported by the on-going subsurface radiation measurements. No subsequent sample data is available that adequately represents the nature of contamination at this site. Based on subsurface radiation profile measurements taken during the Track 2 investigation, significant radioactive contamination is present at this site to pose an unacceptable risk.

A summary of the primary uncertainties related to the risk calculations for site CPP-31 are provided in Table 4-16. The overall uncertainty has a moderate to high potential to either over- or underestimate the risk.

4.3.5 Human Health Assessment

Risks greater than 1E-04 were calculated for the external exposure pathway in all three scenarios evaluated (current occupational [1.0E+00], future recreational [2.4E-02], and future residential [2.3E-01]). The risks were calculated using the upper 95% confidence limit concentration of the soil samples collected in 1975 and decayed to 1992 concentrations. Since a sample depth was not associated with any of these samples, it is likely that the external exposure pathway would be incomplete for both the current occupational and future recreational scenarios since the contamination is probably deeper than four feet. In any event, all ICPP workers are closely supervised to minimize exposures, and the radiation levels within the Tank Farm are monitored closely by the WINCO Environmental Safety and Health Department so that unacceptable exposure to occupational receptors does not occur.

Table 4-16. Uncertainty Assessment for site CPP-31

Assumption	Effect on Exposure[1]		
	Potential Magnitude for Over-Estimation of Exposure	Potential Magnitude for Under-Estimation of Exposure	Potential Magnitude for Over- or Under-Estimation of Exposure
Environmental Sampling and Analysis			
Nature and extent of contamination based on the analytical results from grab samples collected in 1975.			High
Gamma emissions indicate that the greatest concentration of radionuclides is below the target depth for most pathways, however, the upper 95% confidence limit concentration was used for risk calculations.	Moderate to High		
Exposure Parameter Estimation			
The standard assumptions regarding body weight, period exposed, life expectancy, population characteristics, and lifestyle may not be representative of the site.	Moderate		
The amount of media intake is assumed to be constant and representative of the exposed population.	Moderate to High		
Assumption of daily lifetime exposure for residents	Moderate to High		
Use of maximum concentration detected for the upper-bound lifetime exposure.			Moderate to High

[1]As a general guideline, assumptions marked as "low" may affect estimates of exposure by less than one order of magnitude; assumptions marked "moderate" may affect estimates of exposure by between one and two orders of magnitude; and assumptions marked "high" may affect estimates of exposure by more than two orders of magnitudes (EPA 1989).

For the future residential scenario, risks greater than 1E-04 were also calculated for the soil and ground water ingestion pathways, respectively. These estimated risks are based on characterization data that have a moderate to high potential to either over- or underestimate the risk.

No soil samples were collected for the risk calculation. As a result, the estimation for the exposure concentration for all receptors is very conservative and based on the highest concentration from all historical samples. In addition, it was then assumed that a future residential receptor is subjected to the contamination for an exposure duration of 24 hours/day, 350 days/year for 30 years. The exposure is projected to begin in 30 years and assumes that no site cleanup occurs.

4.4 CPP-32E (Contaminated Soil Adjacent to Valve Box B-4)

The contamination at this site is suspected to have originated from a surface release of condensate originating from a vent tube in Valve Box B-4 (Figure 2-2). The area of contamination was originally identified as 8 ft^2 and extended to a depth of 12 inches bls. Since the discovery of the contamination, the area has been covered with approximately 2 feet of soil, the tank farm membrane, and an additional six inches of soil. All depths referenced in the Borehole Logs and the subsequent discussion are based on the 0 datum being the tank farm membrane.

4.4.1 Nature and Extent of Contamination

One soil boring was drilled adjacent to the vent tube to a maximum depth of five feet below the membrane. The soil boring was unable to advance to the projected depth of 6 feet due to encountering a concrete valve box. From this borehole, soil samples were collected and measured in the field for gross beta-gamma radiation using a hand-held frisker (Ludlum-2A). The results from this sampling are provided in Table 4-17. This field screening detected the highest radiation at 900 counts per minute (cpm) above background between 1.4 and 2.9 feet below the membrane, roughly equivalent to the depth of the original land surface at the time of the release. At the bottom of the borehole, the beta-gamma radiation had decreased to 250 cpm above background. Based upon the field radiation measurements, one soil sample was collected at a depth of 1.4-2.3 feet and two soil samples were collected at a depth of 2.2-2.9 feet.

4.4.1.1 Volatile Organic Compounds. The only volatile organic compound detected at this site was toluene at an estimated concentration of 1 μg/kg. The concentrations of toluene detected is extremely low. There are a number of possible on-site sources for the presence of toluene that include: vehicle exhaust, industrial processes, or other on site sources. In addition, toluene is also a common lab contaminant and the low levels of toluene detected could be the result of laboratory contamination. In any event, the concentration detected is highly unlikely to pose any risk to human health.

Table 4-17. Results From the Soil Samples Analyzed at Site CPP-32E

Borehole Depth (feet) Sample Number	CPP-32E-1 (1.4 - 2.3) 30701001 Concentration mg/Kg or pCi/g			Q	CPP-32E-1 (2.2 - 2.9) 30701101 Concentration mg/Kg or pCi/g			Q	CPP-32E-1 (2.2 - 2.9) 30701201 Concentration mg/Kg or pCi/g			Q
Chemical Parameters												
Toluene	1.00E-03			J	1.00E-03			J	1.00E-03			J
Mercury	2.20E-01				3.00E-01				1.60E-01			
pH	9.27E+00				9.26E+00				9.36E+00			
Radionuclides			Uncertainty				Uncertainty				Uncertainty	
Gross Alpha	1.96E+01	±	2.63E+00	J	2.15E+01	±	2.97E+00		1.48E+01	±	2.10E+00	
Gross Beta	7.24E+02	±	5.86E+01		3.58E+02	±	2.92E+01		3.50E+02	±	2.87E+01	
Cs-137	2.77E+02	±	2.11E+01	J	1.51E+02	±	1.27E+01		1.33E+02	±	1.12E+01	
Eu-154	4.56E-01	±	6.59E-02	J	8.11E-01	±	9.25E-02		5.35E-01	±	7.58E-02	
K-40	1.86E+01	±	9.95E-01	J	1.87E+01	±	1.12E+00		2.10E+01	±	1.13E+00	
Sr-90	2.78E+02	±	1.46E+01	J	1.52E+02	±	9.56E+00		2.44E+02	±	1.41E+01	
U-234	NA	±	NA		NA	±	NA		NA	±	NA	
U-235	NA	±	NA		NA	±	NA		NA	±	NA	
U-238	NA	±	NA		NA	±	NA		NA	±	NA	
Pu-238	NA	±	NA		NA	±	NA		NA	±	NA	
Pu-239	NA	±	NA		NA	±	NA		NA	±	NA	
Pu-242	NA	±	NA		NA	±	NA		NA	±	NA	
Am-241	NA	±	NA		NA	±	NA		NA	±	NA	

Q = Data Qualifier
ND = No Data
NA = Not Analyzed
U = Not Detected

4.4.1.2 Inorganic Compounds. Based upon the type of release (i.e., condensate from a valve box), only a limited number of inorganic analyses were performed on the samples taken from this site. Targeted analytes include mercury, cadmium, and soil pH. Of the two metals analyzed, only mercury was detected. It was detected at concentrations ranging from 0.16 mg/kg to 0.30 mg/kg, which are above the background concentrations provided in Table 3-1. No indication of soil contamination was noted in the pH measurements.

4.4.1.3 Radionuclides. The gross alpha concentrations from the three samples ranged from 14.8 pCi/g to 21.5 pCi/g and were within normal background concentrations. Therefore, no isotopic analysis of the alpha-emitting radionuclides was performed. The gross beta concentrations from the three samples range from 350 pCi/g to 724 pCi/g with the subsequent isotopic analysis of Sr-90 ranging from 153 pCi/g to 278 pCi/g. Of the man-made gamma-emitting radionuclides, only Cs-137 at concentrations ranging from 133 pCi/g to 277 pCi/g and Eu-154 at concentrations ranging from 0.456 pCi/g to 0.811 pCi/g were detected.

4.4.2 Quantification of Exposure

The potential risk at this site is from exposure to Sr-90, Cs-137, Eu-154, and mercury. All these contaminants were detected at concentrations that exceed the background concentrations listed in Table 3-1.

Since only three samples were analyzed at this site, it is not possible to calculate the exposure concentration using the upper 95% confidence limit. Therefore, the maximum concentrations detected at the site were used in the risk calculations.

The contaminants were initially detected at a depth of approximately 2 feet bls, roughly equivalent to the depth of the original land surface at the time of the release. This depth of contamination is consistent with the subsequent covering of the area with 2 feet of soil, the tank farm membrane, and an additional six inches of soil on top of the membrane in 1978. Since these contaminants were detected at a depth below 2 feet, screening by pathway eliminated the fugitive dust inhalation and soil ingestion for the current occupational and future recreational scenarios. As a result, only the external exposure pathway was evaluated for these two scenarios with the lifetime intake values being presented in Table 4-18.

For the future residential scenario, all exposure pathways are complete with the lifetime intake values being presented in Table 4-18. Based upon an evaluation of the ground water pathway using GWSCREEN, the peak water concentrations for Sr-90, Cs-137, and Eu-154 are 2.3E-13 pCi/l, 5.2E-221 pCi/l, and 9.1E-28 pCi/l, respectively. These extremely low concentrations are the result of radioactive decay during the unsaturated travel. In addition, the peak water concentration for mercury was calculated at 9.3E-12 mg/kg. This low concentration is attributed to a low source concentration and sorptive forces. Therefore, risk calculations associated with the ground water pathway will not be discussed further.

Table 4-18. Lifetime Intake and Exposure Table for CPP-32E

OU: 3-07 Site: CPP-32E

Contaminant	Source SC (pCi/g or mg/kg)	Current Occupational Scenario			Future Residential Scenario						Future Recreational Scenario		
		Soil Ingestion	Inhalation of Fugitive Dust	External Exposure	Soil Ingestion	Inhalation of Fugitive Dust	Ground Water Ingestion			External Exposure	Soil Ingestion	Inhalation of Fugitive Dust	External Exposure
		Intake (pCi)	Intake (pCi)	Intake (pCi-yr/g)	Intake (pCi)	Intake (pCi-yr/g)	Travel Time (years)	Half-life (years)	Intake (pCi)	(pCi-yr/g)	Intake (pCi)	Intake (pCi)	(pCi-yr/g)
Strontium-90	2.8E+02	(1)	(1)	(3)	1.7E+05	3.7E-01	9.7E+02	2.9E+01	3.0E-07	3.8E+03	(1)	(1)	(3)
Cesium-137	2.8E+02	(1)	(1)	1.6E+03	1.8E+05	3.8E-01	1.5E+05	3.0E+01	1.0E-216	4.0E+03	(1)	(1)	3.8E+00
Europium-154	8.1E-01	(1)	(1)	4.6E+00	9.9E+01	2.1E-04	5.5E+01	8.6E+00	7.7E-02	2.2E+00	(1)	(1)	2.1E-03
		(mg/kg-d)	(mg/kg-d)	(mg/kg-d)	(mg/kg-d)	(mg/kg-d)	Travel Time (years)	Half-life (years)	(mg/kg-d)	(mg/kg-d)	(mg/kg-d)	(mg/kg-d)	(mg/kg-d)
Mercury	3.0E-01(2)	(1)	(1)	NA	1.1E-06(2)	2.6E-13(2)	3.0E+04	NA	9.3E-13(2)	NA	(1)	(1)	NA

SC = Soil Concentration (mg/kg for nonradioactive; pCi/g for radioactive)
NA = Not applicable
Note: Soil concentrations based on the maximum concentration measured from borehole CPP-32E-1 (see text).

1 Pathway not complete (no contamination detected in upper 6 inches).
2 All concentrations in mg/kg.
3 No gamma emissions, pathway not complete.

4.4.3 Risk Characterization Summary

Cancer risks, and the non-carcinogenic effects from exposure to mercury, were calculated from the estimated lifetime intake values in Table 4-18 and are summarized in Table 4-19.

Due to a break in the pathway caused by the depth of contamination, this site poses no risk from the soil ingestion or fugitive dust inhalation pathways to current occupational and future recreational receptors; No risks greater than 1E-04 were calculated for these two pathways in the future residential scenario. The only risks greater than 1E-04 are from external exposure where the cumulative risk for the current occupational, future residential, and future recreational scenarios are 3.2E-03, 1.6E-03, and 1.5E-06, respectively. These risks are due to the presence of Cs-137 at the maximum concentration detected at the site of 280 pCi/g.

The non-carcinogenic effects from exposure to mercury were evaluated using the maximum concentration detected in the soil. This estimation resulted in a maximum hazard quotient for the soil ingestion pathway of 3.7E-03, which is substantially less than the threshold value of 1.

4.4.4 Uncertainty Discussion

The nature and extent of contamination from this site is based upon the results of three soil samples collected near the point of release. These samples detected slightly elevated (i.e., above background) concentrations of radionuclides (Cs-137, Sr-90, and Eu-154) and mercury. Since these samples were collected as close to the original release as possible, these concentrations should be the highest encountered throughout the site. By using the highest values at the site, the exposure concentrations are conservatively estimated and the resulting risk is greater than the actual risk. An evaluation of the uncertainty associated with the risk calculations for this site is provided in Table 4-20. The uncertainty associated with the estimated risks is moderate to high and the calculated risks likely overestimate the actual risks.

4.4.5 Human Health Assessment

For the current occupational receptor, the only complete pathway for exposure to contaminants at this site is from external exposure. The risk is calculated assuming that a current occupational receptor is subjected to the contamination for the exposure duration of 8 hour/day, 250 days/year for 25 years without any institutional controls. The cumulative risk from the external exposure pathway is 3.2E-03 due to exposure to Cs-137. With the current institutional controls that restricts entry to the tank farm and closely monitors radiation doses received by occupational receptors, this exposure scenario is unlikely.

Table 4-19. Risk Assessment Summary Table for CPP-32E

OU: 3-07 Site: CPP-32E

Contaminant	Source SC (pCi/g or mg/kg)	Current Occupational Scenario			Future Residential Scenario						Future Recreational Scenario		
		Soil Ingestion	Inhalation of Fugitive Dust	External Exposure	Soil Ingestion	Inhalation of Fugitive Dust	Ground Water Ingestion			External Exposure	Soil Ingestion	Inhalation of Fugitive Dust	External Exposure
		Cancer risk	Cancer risk	Cancer risk	Cancer risk	Cancer risk	Travel Time (years)	Half-life (years)	Cancer risk	Cancer risk	Cancer risk	Cancer risk	Cancer risk
Strontium-90	2.8E+02	(1)	(1)	(2)	5.7E-06	2.0E-11	9.7E+02	2.9E+01	9.9E-18	(2)	(1)	(1)	(2)
Cesium-137 +d	2.8E+02	(1)	(1)	3.2E-03	5.1E-06	7.3E-12	1.5E+05	3.0E+01	2.9E-227	8.1E-03	(1)	(1)	7.5E-06
Europium-154	8.1E-01	(1)	(1)	1.9E-05	3.0E-10	2.9E-14	5.5E+01	8.6E+00	5.4E-36	9.1E-06	(1)	(1)	8.4E-09
CUMULATIVE SUM				3.2E-03	1.1E-05	2.7E-11			9.9E-18	8.1E-03			7.5E-06
		HQ	HQ	HQ	HQ	HQ	Travel Time (years)	Half-life (years)	HQ	HQ	HQ	HQ	HQ
Mercury (3)	3.0E-01	(1)	(1)	NA	3.7E-03(3)	3.0E-09(3)	3.0E+04	NA	3.1E-09(3)	NA	(1)	(1)	NA
CUMULATIVE SUM				NA	3.7E-03	3.0E-09			3.1E-09	NA			NA

SC = Soil concentration (mg/kg for nonradioactive; pCi/g for radioactive).
NA = Not Applicable
Note: Soil concentrations based on the maximum concentration measured for borehole CPP-32E-1 (see text).
+d Includes risk due to progeny.
1 Pathway not complete (no contamination detected in upper 6 inches).
2 No emissions, pathway not complete.
3 Hazard Quotient.

Table 4-20. Uncertainty Assessment for site CPP-32E

Assumption	Effect on Exposure[1]		
	Potential Magnitude for Over-Estimation of Exposure	Potential Magnitude for Under-Estimation of Exposure	Potential Magnitude for Over- or Under-Estimation of Exposure
Environmental Sampling and Analysis			
Sufficient samples may not have been collected to characterize the media being evaluated, especially with respect to currently available soil data.	Low to moderate		
Exposure Parameter Estimation			
The standard assumptions regarding body weight, period exposed, life expectancy, population characteristics, and lifestyle may not be representative of any actual exposure situation.	Moderate		
The amount of media intake is assumed to be constant and representative of the exposed population.	Moderate to High		
Assumption of daily lifetime exposure for residents	Moderate to High		
Use of the maximum concentration detected in the "hot spot" for the upper-bound lifetime exposure.	Moderate to High		

[1]As a general guideline, assumptions marked as "low" may affect estimates of exposure by less than one order of magnitude; assumptions marked "moderate" may affect estimates of exposure by between one and two orders of magnitude; and assumptions marked "high" may affect estimates of exposure by more than two orders of magnitude (EPA 1989).

Based upon the depth to contamination, all pathways are complete for the future residential scenario. The external exposure pathway is the only pathway having a risk greater than 1E-04 due to exposure to Cs-137. This risk is calculated using the maximum Cs-137 concentration detected in the soil, and assumes that this concentration is representative of the site. Since these soil samples were collected as close to the release as possible, the Cs-137 concentrations are expected to decrease in both the lateral and vertical directions. The vertical decline in concentrations is supported by a decrease in the gross beta-gamma radiation measured in the borehole (Borehole Logs - Appendix B). Therefore, a more reasonable estimate of the exposure concentration will likely reduce the overall calculated risk to a future residential receptor.

For a future recreational receptor, the only complete pathway for exposure to contaminants at this site is from external exposure. The cumulative risk calculated for external exposure is 7.5E-06.

4.5 CPP-79 (Tank Farm Release Near Valve Box)

Overhead condensate was transferred routinely from the Waste Calcining Facility (WCF) to tank WL-102 in the PEW system as a part of operations. This waste contained low-level radioactivity, heavy metals, and traces of organic compounds. Approximately 2500 gallons of the overhead condensate was released during transfers in July and August, 1976. The release apparently resulted from condensate backing up in the transfer line and into an open drain line from which it moved into valve box A-2. The exact geometry of the contaminated zone was not determined but waste apparently was concentrated to the west of valve box A-2 and affected approximately 150 yd^3 of soil. The transfer line and valve box was buried at a depth of approximately 10 feet bls, and the solution probably moved downwards from this level.

The overhead condensate was analyzed shortly after the release and contained the following constituents (1 Ci = 3.7E + dps):

•	2.39E0	decays/sec/ml	I-129;
•	7.0E+2 ± 2.3E+1	decays/sec/ml	H-3;
•	9.6E+3 ± 9.5E+2	decays/min/ml	gross beta; and
•	8.4E-5 ± 1.1E-5	grams/liter	uranium.

4.5.1 Nature and Extent of Contamination

During the Track 2 investigation, one soil boring was drilled in the alluvium near the release to determine the type and concentration of the residual contamination and to characterize the deeper strata in the Tank Farm area. The borehole location was on a berm approximately 8 feet above the land surface in the tank farm. As a result, the land surface elevation corresponds to a depth of eight feet in the Borehole Log (Appendix B).

A total of 15 split spoon samples were collected from the borehole as shown in the Borehole Log (Appendix B). The split spoon samples were screened in the field for gross beta-gamma radiation and a total of 7 samples were selected from the zones having the highest radiation for further analysis. Two of the soil samples admitted for analysis were duplicates (30701601 and 30701701; collected between 32 and 36 ft bls) and one sample was too radioactive to be transported

offsite (30702101; collected from 41.5 and 42.0 ft bls). The remaining samples were analyzed for volatile organic compounds, TAL metals, nitrate/nitrite, pH, and radionuclides as shown in Table 4-21.

4.5.1.1 Volatile Organic Compounds. The only volatile organic compound detected at this site was acetone. Raw acetone values for the soil samples ranged from a low of 14 µg/kg to a high of 65 µg/kg. Acetone is a common laboratory contaminant and concentrations of up to 120 µg/kg were found in the blanks associated with the samples. The EPA CLP data validation guidelines require that a detection limit of ten times the highest value found in any blank be used for all samples associated with the blank. Therefore, acetone, is reported as <1200 µg/kg and as a result, there were no volatile organic compounds detected in any of the soil samples.

4.5.1.2 *Inorganic Compounds.* *Mercury and cadmium were identified in the* SAP as possible constituents of concern for samples collected at CPP-79. Samples were analyzed for these constituents, however mercury and cadmium concentrations in all samples were below the method detection limits.

The soil samples (with the exception of 30702201) were analyzed for nitrate/nitrite. Nitrate was detected in all samples at concentrations between 0.46 and 2.3 mg/kg. Nitrite was not detected in any of the samples. Nitrate is a essential nutrient for plant growth and a natural soil component of soils. Nitrate is of concern at the ICPP because the processes utilized to dissolve fuel rods requires nitric acid. The levels found in the soil samples are not elevated over levels which might be expected in soils; the levels are well below the application rates generally utilized in agriculture; and there are no other constituents of concern associated with the nitrate. The nitrate, therefore, does not appear to be a constituent of concern at this site.

4.5.1.3 Radionuclides. All samples were analyzed for gross-alpha and gross-beta emitting radionuclides, with the exception of 30702101 which was too radioactive to analyze. Samples collected above 36 feet bls had relatively low activities:

- gross alpha activities ranged from 8.25 to 22.2 pCi/g (highest between 22 and 24 ft);
- gross beta activity ranged from 23.7 to 158 pCi/g (highest between 22 and 24 feet);
- Cs-137 activity ranged from 0.048 to 20.9 pCi/g (highest between 22 and 24 feet);
- Eu-154 was not detected in any of the samples; and
- K-40 activity varied between 18.6 and 22.9 pCi/g.

Figure 4-8 shows the vertical distribution of the detected radionuclides. For depths less than 36 feet, the gross alpha activity, slightly exceeded the background levels in the sample collected between 22 and 24 feet. This sample interval also has detectible levels of U-238 and U-235 at concentrations near background levels and Pu-238 and Pu-239. Gross alpha activity was below background levels at depths below 24 feet.

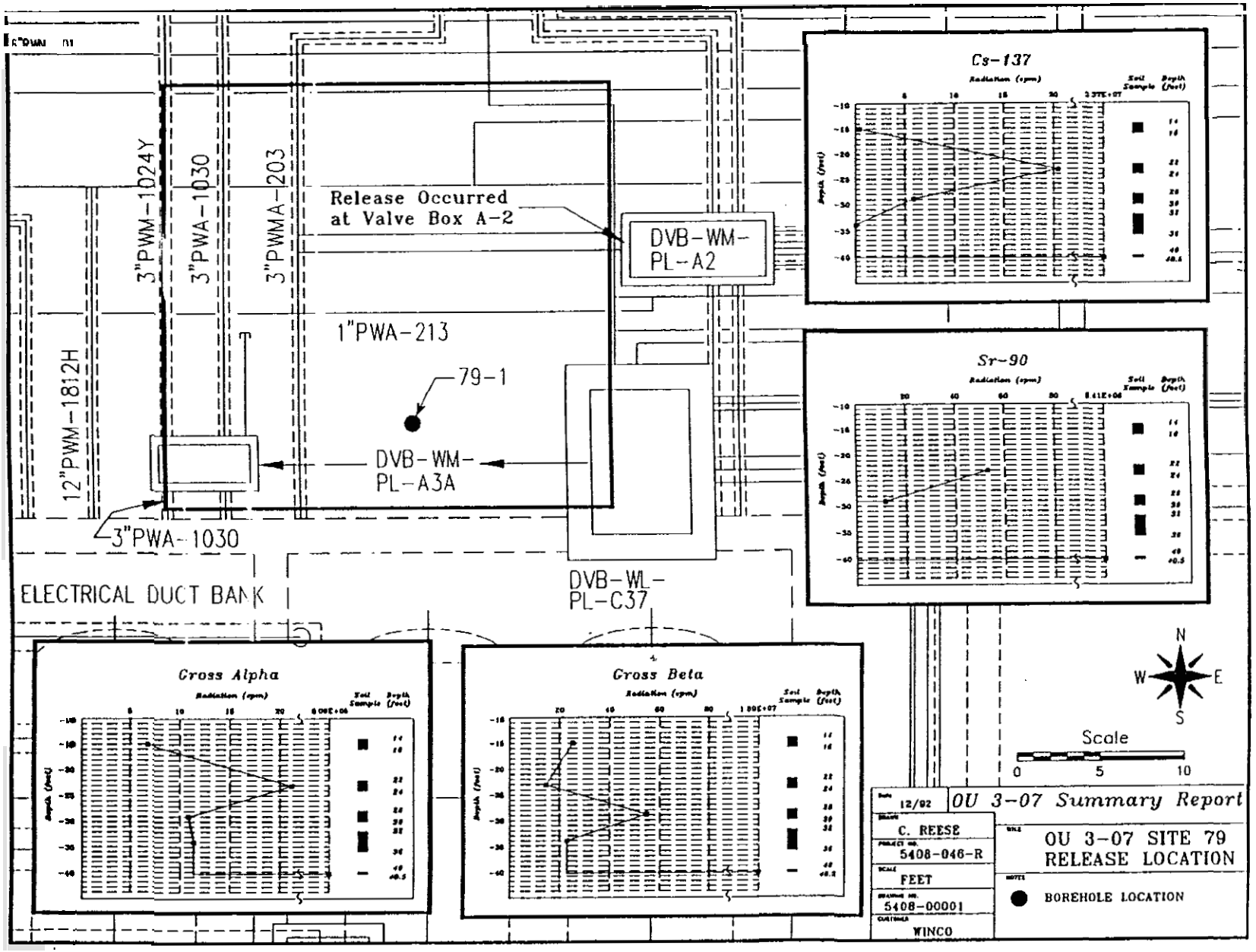
Table 4-21. Results of the Soil Analyses from Site CPP-79

Borehole Depth (feet) Sample Number	CPP-79-1 (14 - 16) 30701301 Concentration mg/Kg or pCi/g			Q	CPP-79-1 (22 - 24) 30701401 Concentration mg/Kg or pCi/g			Q	CPP-79-1 (28 - 30) 30701501 Concentration mg/Kg or pCi/g			Q
Chemical Parameters												
Toluene	5.00E-03			U	5.00E-03			U	5.00E-03			U
Mercury	5.00E-02			U	5.00E-02			U	5.00E-02			U
Nitrate	8.00E-01			J	4.60E-01			J	2.30E+00			J
Nitrite	2.10E-01			UJ	2.20E-01			UJ	2.20E-01			UJ
pH	9.28E+00				9.11E+00				9.11E+00			
Radionuclides			Uncertainty				Uncertainty				Uncertainty	
Gross Alpha	8.25E+00	±	1.31E+00		2.22E+01	±	2.97E+00		1.19E+01	±	1.70E+00	
Gross Beta	2.55E+01	±	2.26E+00		1.58E+02	±	1.29E+01		5.55E+01	±	4.85E+00	
Cs-137	5.14E-01	±	3.77E-02		2.09E+01	±	1.50E+00		6.18E+00	±	4.19E-01	
Eu-154	ND	±	ND	U	ND	±	ND	U	ND	±	ND	U
K-40	1.86E+01	±	9.07E-01		2.05E+01	±	1.02E+00		1.86E+01	±	9.00E-01	
Sr-90	NA	±	NA		5.44E+01	±	3.46E+00		1.20E+01	±	1.20E+00	
U-234	NA	±	NA		5.55E+00	±	2.46E-01		NA	±	NA	
U-235	NA	±	NA		1.60E-01	±	2.67E-02		NA	±	NA	
U-238	NA	±	NA		1.39E+00	±	9.07E-02		NA	±	NA	
Pu-238	NA	±	NA		1.30E-01	±	2.71E-02		NA	±	NA	
Pu-239	NA	±	NA		9.78E-02	±	2.34E-02		NA	±	NA	
Pu-242	NA	±	NA		NA	±	NA		NA	±	NA	
Am-241	NA	±	NA		3.32E-01	±	5.83E-02		NA	±	NA	

Borehole Depth (feet) Sample Number	CPP-79-1 (32 - 36) 30701601 Concentration mg/Kg or pCi/g			Q	CPP-79-1 (32 - 38) 30701701 Concentration mg/Kg or pCi/g			Q	CPP-79-1 (40-40.5) 30702201 Concentration mg/Kg or pCi/g			Q
Chemical Parameters												
Toluene	5.00E-03			U	5.00E-03			U	NA			
Mercury	5.00E-02			U	5.00E-02			U	NA			
Nitrate	1.80E+00			J	1.20E+00			J	NA			
Nitrite	2.10E-01			UJ	2.10E-01			UJ	NA			
pH	9.19E+00				9.31E+00				NA			
Radionuclides			Uncertainty				Uncertainty				Uncertainty	
Gross Alpha	1.26E+01	±	1.91E+00		1.12E+01	±	1.67E+00		8.09E+05	±	9.71E+04	
Gross Beta	2.37E+01	±	2.13E+00		2.46E+01	±	2.16E+00		1.89E+07	±	1.52E+06	
Cs-137	4.78E-02	±	5.83E-03		1.15E-01	±	9.59E-03	J	3.37E+07	±	1.06E+06	
Eu-154	ND	±	ND	U	ND	±	ND	UJ	ND	±	ND	U
K-40	2.29E+01	±	1.09E+00		1.88E+01	±	8.96E-01	J	ND	±	ND	U
Sr-90	NA	±	NA		NA	±	NA		5.41E+06	±	4.91E+03	
U-234	NA	±	NA		NA	±	NA			R		
U-235	NA	±	NA		NA	±	NA			R		
U-238	NA	±	NA		NA	±	NA			R		
Pu-238	NA	±	NA		NA	±	NA			R		
Pu-239	NA	±	NA		NA	±	NA			R		
Pu-242	NA	±	NA		NA	±	NA		NA	±	NA	
Am-241	NA	±	NA		NA	±	NA		1.66E+04	±	2.18E+03	J

Q = Data Qualifier
ND = No Data
NA = Not Analyzed
U = Not Detected
J = Estimated concentration (below method detection limit)
R = Data not usable for any purposes

Figure 4-8. Subsurface Radiation Profiles for Site CPP-79.



Gross beta activities were elevated above background levels in the samples collected from 22 to 24 feet and 28 to 30 feet. Cs-137 concentrations were also elevated above background in these same intervals.

The soil samples collected between 32 and 36 feet showed radionuclide concentrations near the background levels provided in Table 3-1.

The original plan called for drilling the borehole through the zone of contamination or if no contamination was detected, to a maximum depth of 25 feet. During the field investigation, it was decided to continue drilling and sampling to the top of basalt to collect as much subsurface information as possible. At a depth of 39 feet however, the HPT screening the drill cuttings detected a sharp increase in radioactivity (> 10,000 cpm above background). On September 4, 1992, a California split-spoon sampler was driven from 40 to 42 feet. This soil sample was then taken to the ICPP laboratory for processing.

Once in the ICPP laboratory, the California split-spoon sampler was opened under an air hood. The sample had a contact surface radian level of ±400 rem/hr beta-gamma. The sample material was then transferred to two 250-ml glass jars: one sample jar filled with the soil from 40 to 40.5 feet bls and one sample jar filled with soil from 41.5 to 42 feet bls. After the sample was containerized, the 40 to 40.5 foot sample had a surface contact ration of ±280 rem/hr. Since this level of radioactivity was above that allowed for chemical analytical laboratory (TCT-St. Louis), it was only shipped to B&W laboratory for radionuclide analysis. The sample collected from 41.5 to 42 feet bls had radiation levels too high to be analyzed by either laboratory and was subsequently disposed back to the borehole as close as possible to where the contamination originated.

The radionuclide analyses from the sample collected from 40 to 40.5 feet measured significantly higher gross alpha and gross beta activities (8.09E+05 pCi/g and 1.89E+07 pCi/g, respectively) than were measured in the above sample intervals. Isotopic analysis of this soil also detected significantly higher concentrations of Cs-137 (3.37E+07 pCi/g), Sr-90 (5.41E+06 pCi/g), Pu-238 (2.76E+05 pCi/g), Pu-239 (8.99E+04 pCi/g), and Am-241 (1.66E+04 pCi/g) than were detected in the above sample intervals. Based upon the significant difference in concentrations and isotopes, it does not appears that the contamination detected at depth is from the same release as the contamination detected above.

4.5.1.4 Nature of Extent Conclusions. The Track 2 investigation shows no evidence for contamination from either volatile organic compounds or metals (mercury or cadmium) at site CPP-79. There appear to be two distinct radionuclide contaminated zones that probably originated from different releases. The uppermost zone was encountered between 22 and 30 feet (14 feet to 22 feet below land surface) in borehole CPP-79-1. This zone is characterized by gross alpha emission slightly in excess of background levels, and by gross beta emissions up to 8x the background level. The elevated gross beta appears to be linked to anthropogenic beta-emitters rather than variations in K-40 (natural beta emitter). The low level of radionuclides found in this zone could be the result of the spill of decontamination solution with dilute radioactivity which occurred at site CPP-79, and which was the original subject of this investigation.

The top of the second radionuclide contaminated zone was encountered in the borehole at a depth of approximately 39 feet bls. This contamination was not

anticipated during project planning and there is no information to assist in defining the bottom, or lateral extent of the contamination. This zone is characterized by radionuclide concentrations that are five orders of magnitude greater than those detected in the overlying zone and appears to be the result of a release of high level liquid waste.

4.5.2 Quantification of Exposure

The potential risk at this site is from exposure to radionuclides. In the sample collected from 40 to 40.5 feet (32 to 32.5 feet bls), the concentrations for all radionuclides are above the background concentrations listed in Table 3-1.

Given the depth of the subsurface release (i.e., >10 feet) and the low beta-gamma radiation measured in the upper 14 feet, the only complete pathway for this site is ground water ingestion to a future residential receptor. To calculate the lifetime exposure rate from the ground water pathway, an estimate of the source volume (length, width, and thickness) and an average concentration of the contaminants must be known for inputs into GWSCREEN. Since this contamination is from an unknown release and was only detected in a single borehole that did not fully penetrate the source, it is not possible to provide reasonable estimates for the GWSCREEN input parameters. Therefore, the lifetime exposure rates for the ground water pathway cannot be calculated with any reasonable uncertainty.

4.5.3 Risk Characterization Summary

The only complete exposure pathway at this site is ground water ingestion. Given the high uncertainty in the contaminated source volume (length, width, and thickness) and the average contaminant concentration, it is not possible to calculate the lifetime exposure rates and the resulting risk. Based on the radionuclide concentrations measured in borehole CPP-79-1, if exposure did occur it is likely that the risks would be greater than 1E-04.

4.5.4 *Uncertainty Discussion*

The uncertainty associated with the nature and extent of contamination at this site is high. Given the unknown source volume of contamination, no risks were calculated.

4.5.5 Human Health Assessment

Based upon the depth at which the release is supposed to have occurred, no soil samples were collected at a depth less than 14 feet bls. This lack of contamination in the upper soil is supported by field radiation measurements where elevated levels of gross beta-gamma radiation were not detected at depths less than 14 feet bls. Therefore, the only complete exposure pathway at this site is from ground water ingestion.

The contamination encountered at this site appears to be from two different releases. Contamination from the release of low-level radioactivity solutions was encountered at depths from 22 to 30 feet (14 to 22 feet bls) and contamination from the release of high level radioactive liquid waste was encountered in the bottom of the borehole, at approximately 39 feet. Given the depth of contamination (i.e., > 10 feet bls), the only complete exposure pathway

is ground water ingestion to a future residential receptor. The estimation of risk for the ground water pathway requires knowledge of the source volume (length, width, and thickness) and average concentration of the contaminates with some reasonable degree of certainty. Too many unknowns concerning the nature and extent of contamination exist at this site to evaluate the risk from the ground water ingestion pathway. Given the high level of contaminants detected in borehole CPP-79-1 however, if exposure did occur it is likely that the risks would be greater than 1E-04.

5.0 PERCHED GROUND WATER NEAR THE TANK FARM

According to the OU 3-07 SAP, the DQOs for the perched ground water are twofold. First, one round of ground water samples was to be collected from Well 55-06 to determine the current water quality. Second, an additional round of ground water samples and water level measurements were to be collected from the tank farm area wells and lysimeters to provide information on the variation in contaminant concentrations and water levels. The wells targeted for this effort include 55-06, TF-1, TF-2, TF-3, TF-4 (deep), and TF-4 (shallow); and the lysimeters targeted for this effort include TF-1L, TF-2L, TF-3L, TF-5L shallow, and TF-5 deep. The well/lysimeter, date sampled, and any comments concerning the sampling operation were provided in Table 2-6.

These wells and lysimeters were sampled in accordance with the procedures described in the *Groundwater Field Sampling Plan for the Idaho Chemical Processing Plant* (A. C. Williams [DOE-ID] letter to Mr. Wayne Pierre [EPA Region X] and Mr. Dean Nygard [IDHW] dated April 24, 1992). If sufficient water was available, the ground water samples were analyzed for the RCRA Groundwater Contamination Parameters (pH, specific conductance, total organic halogen, and total organic carbon), the RCRA Groundwater Quality Parameters (barium, cadmium, chromium, silver, arsenic, lead, selenium, mercury, fluoride, nitrate, endrin, lindane, methoxychlor, toxaphene, 2,4-D, silvex, gross alpha, and gross beta), miscellaneous parameters (calcium, magnesium, potassium, zirconium, bicarbonate, carbonate, and nitrate), and radionuclides (Sb-125, Cs-137, Co-60, I-129, Sr-90, and tritium). In addition to providing the results from this round of sampling as required by the DQOs, this section incorporates the results from the previous two quarterly sampling rounds performed under DOE Order 5400.1.

5.1 Water Level Measurements

The locations of the monitoring wells completed in the perched ground water created by the 110 foot interbed and lysimeters completed in the vadose zone near the tank farm are shown in Figure 5-1. Water level measurements have been collected for the monitoring wells since February 1992 with an increase in frequency since September 1992. These measurements are provided in Table 5-1 and water level variations vs time are plotted in Figure 5-2.

A water level contour map depicting the geometry of the perched water body in the vicinity of the tank farm was not prepared. This is because there is insufficient well control to determine whether these wells intercept a single water body or are completed in several different water bodies. The water level elevations support both a single or multiple ground water body(s). The ground water chemistry, presented in a later section, supports multiple sources for water recharging the perched ground water created by the 110 foot interbed. Whether or not these sources coalesce into one single ground water body depends upon the volume of recharge from each source and the infiltration rate through the perching layer. Additional data is required in order to determine the geometry of the perched water adequately.

Figure 5-1. Locations of the Perched Water Wells and Lysimeters Near the Tank Farm.

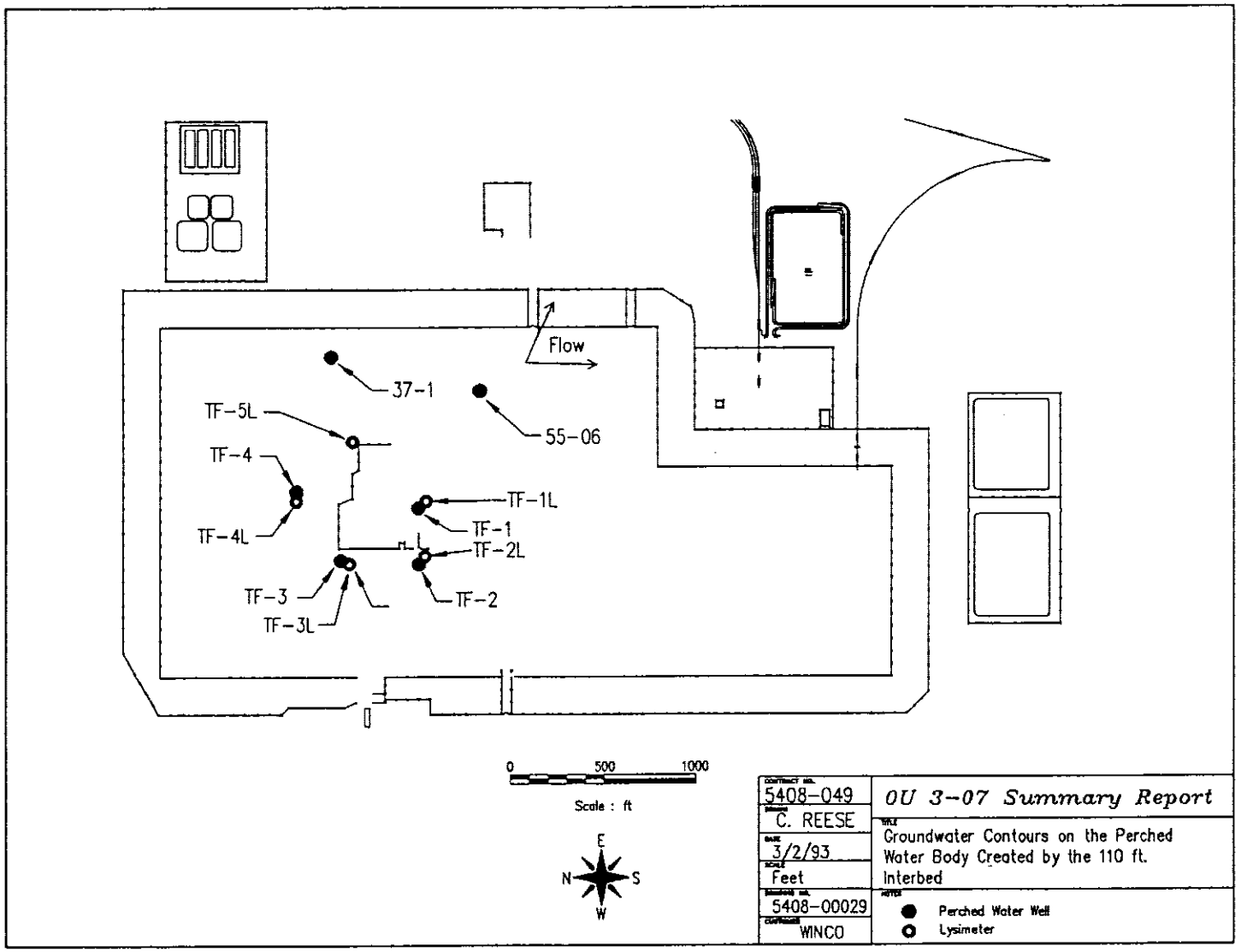
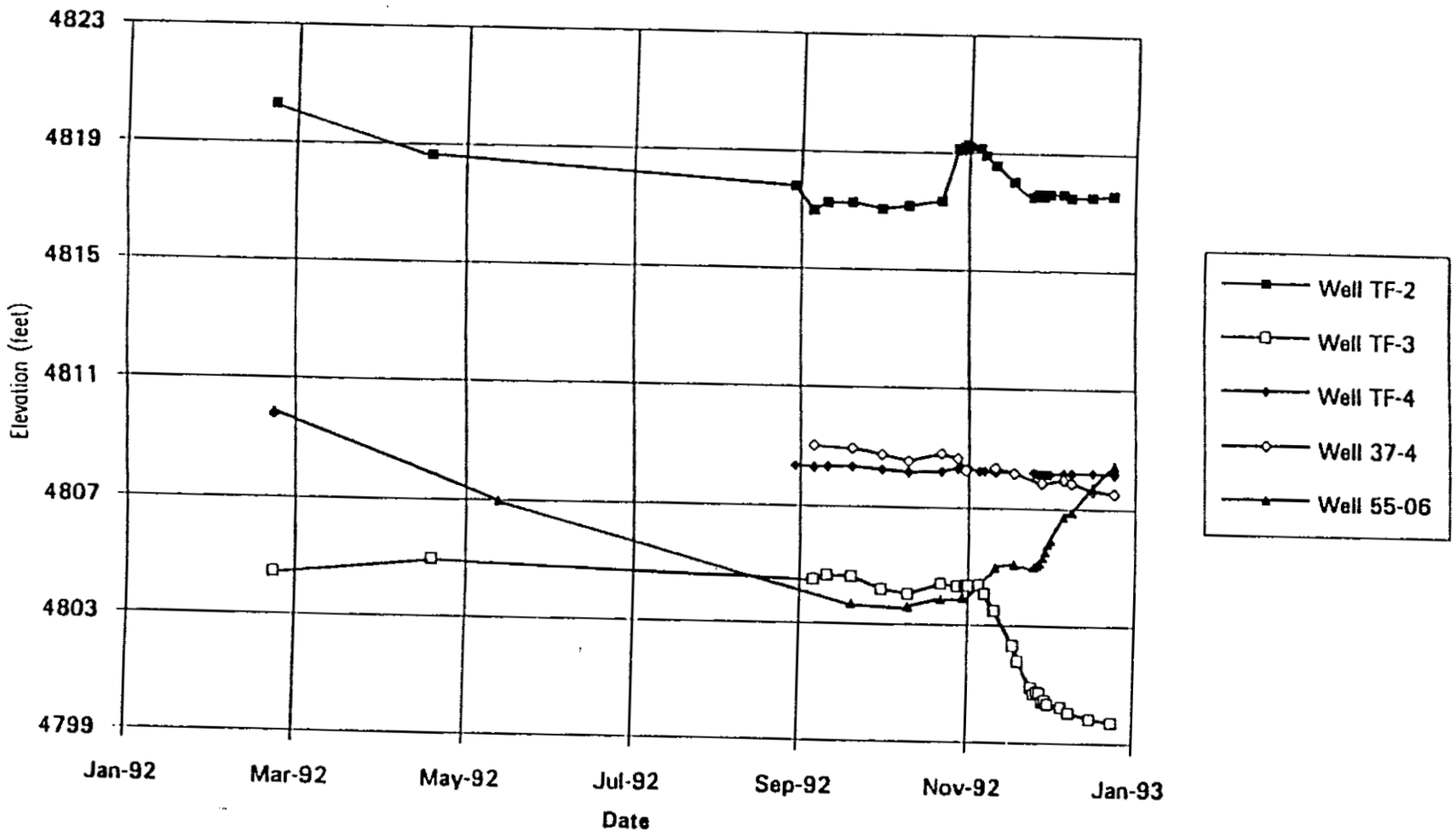


Table 5-1. 1992 Water Level Measurements from the Tank Farm Perched Water Wells

Date	Well TF-2 Elevation (feet)	Well TF-3 Elevation (feet)	Well TF-4 Elevation (feet)	Well 37-4 Elevation (feet)	Well 55-06 Elevation (feet)
2/24/92	4820.32	4804.45	4809.83	ND	4809.91
5/16/92	ND	ND	ND	ND	4807.00
4/21/92	4818.65	4804.95	ND	ND	ND
9/3/92	4817.82	ND	4808.38	ND	ND
9/10/92	4817.01	4804.48	4808.32	4809.06	ND
9/15/92	4817.26	4804.63	4808.35	ND	ND
9/24/92	4817.28	4804.60	4808.35	4808.99	4803.71
10/5/92	4817.08	4804.17	4808.27	4808.77	ND
10/15/92	4817.19	4804.03	4808.19	4808.57	4803.61
10/27/92	4817.37	4804.38	4808.23	4808.83	4803.88
11/2/92	4819.16	4804.30	4808.34	4808.68	ND
11/3/92	4819.10	ND	ND	ND	ND
11/4/92	4819.22	ND	ND	ND	4803.92
11/5/92	4819.31	4804.34	4808.34	4808.26	ND
11/6/92	4819.23	4804.32	4808.34	ND	ND
11/10/92	4819.17	4804.37	4808.27	ND	ND
11/12/92	4818.94	4804.07	4808.26	ND	ND
11/16/92	4818.59	4803.50	4808.22	4808.37	4804.98
11/23/92	4818.05	4802.32	4808.23	4808.18	4805.09
11/25/92	ND	4801.80	ND	ND	ND
11/30/92	4817.54	4800.91	4808.23	ND	4805.01
12/1/92	4817.57	4800.68	4808.18	ND	4805.07
12/2/92	4817.65	4800.77	4808.17	ND	4805.16
12/3/92	4817.65	4800.71	4808.17	4807.87	4805.35
12/4/92	4817.55	4800.40	4808.16	ND	4805.54
12/5/92	4817.64	4800.46	4808.16	ND	4805.81
12/6/92	4817.62	4800.34	4808.16	ND	4805.93
12/11/92	4817.63	4800.23	4808.20	4807.98	4806.75
12/14/92	4817.51	4800.06	4808.21	4807.87	4806.91
12/22/92	4817.53	4799.84	4808.22	4807.62	4807.74
12/30/92	4817.59	4799.73	4808.18	4807.53	4808.49

ND = No Data (water levels were not measured).

Figure 5-2. Water Level Elevations vs Time for the Perched Water Wells Near the Tank Farm



5.2 Perched and Vadose Zone Ground Water Quality

This section summarizes the quality of the perched and vadose zone ground water from the wells and lysimeters completed near the tank farm. Subsection 5.2.1 describes the results from the monitoring well samples and subsection 5.2.2 describes the results from the lysimeters.

5.2.1 Perched Ground Water Quality

The results from the water samples collected from the perched ground water is provided below. It should be noted that the perched ground water beneath the tank farm is not used as a source for drinking water, nor will it ever be used for such purposes. Therefore, it is unreasonable to compare the water quality in the perched water to the federal drinking water standards. Contaminants are monitored in the perched ground water to determine if there is an unacceptable risk of contaminating the Snake River Plain Aquifer.

The quality of the perched ground water created by the 110 foot interbed in the vicinity of the tank farm measured in April 1991 is provided in Table 5-2. Results from the chemical analyses indicate that none of the chemical parameters exceeded either the Federal Primary or Secondary Drinking Water Standards (MCLs) from any of the wells. The results from the radiological analyses determined that the primary radionuclide contaminant is Sr-90. Elevated Sr-90 was measured in Wells 55-06, TF-4, and TF-2 at concentrations of 37,143$\pm$86 pCi/l, 374$\pm$9 pCi/l, and 64.6$\pm$4.6 pCi/l, respectively. The concentrations from all these wells significantly exceed the Federal MCL for Sr-90 of 8 pCi/l. Other fission products detected in the ground water include Cs-137 at concentrations ranging from 49.8$\pm$19.8 pCi/l to 1048$\pm$38 pCi/l, and possibly Cs-134 in one well at a concentration of 5.6$\pm$2.4 pCi/l.

The calculated gross alpha activity ranged from 8.3 pCi/l to 219.9 pCi/l based on the concentration of the detected actinides. The Federal MCL for gross alpha activity is 15 pCi/l. The primary contributors to the alpha activity are Am-241 (25.3$\pm$6.3 pCi/l), Np-237 (10$\pm$5 to 215$\pm$10 pCi/l), and U-234 and U-238 (3.1$\pm$1.2 to 9$\pm$2.1 pCi/l each). Uranium is naturally occurring and the concentrations detected in the perched water are not significantly above background (9 pCi/l). Neither Am-241 nor Np-237 occurs naturally, however.

In 1992, two rounds of quarterly ground water sampling were performed prior to the Track 2 investigation and one round of ground water sampling was performed as part of the Track 2 investigation. These three rounds of ground water samples were collected during February 1992, April/May 1992, and September 1992. The results from these analyses are summarized in Table 5-3. A discussion of these results are provided in the following subsections.

Table 5-2a. Summary of Chemical Analysis from Tank Farm Wells and Well 55-06(April 1991)

(all values in μg/L, unless noted)

Well ID (Sample date)	TF-2 (4/5/91)	TF-3 (4/5/91)	TF-4 (east) (4/10/91)	Well 55-06 (4/10/91)
Alkalinity as $CaCO_3$, mg/L	172.1	186	255	160
Bromide, mg/L	0.7	2540	1.72	1.05
Chloride, mg/L	19.9	193	105	35.9
Conductance, μmhos/cm²	394	986	1140	492
Nitrate as N, mg/L	0.1 U	0.2	1.5	4.2
Nitrite as N, mg/L	0.1 U	0.1 U	0.1 U	0.1 U
pH, s.u.	7.44	7.90	7.79	7.98
TDS, mg/L	253	639	930	429
Sulfate, mg/L	30.6	71.1	60.9	325
Arsenic	10 U	10 U	10 U	10 U
Barium	270	340	850	400
Cadmium	1.0 U	1.0	1.0	1.0 U
Calcium	41700	83800	122000	478000
Chromium	30 U	40	30	30 U
Iron	70	30	120	40
Lead	2.0	5.0	15	4.0
Magnesium	11800	22800	32900	13600
Manganese	30 U	30 U	30 U	30 U
Mercury	0.2 U	0.2	0.4	0.8
Nickel	30 U	30 U	30 U	30 U
Potassium	1700	4200	3700	3300
Selenium	10 U	10 U	10 U	10 U
Silver	30 U	30 U	30 U	30 U
Sodium	15000	69900	34300	25000
Zinc	60	80	80	40
Carbon Disulfide	5 U	5 U	5 U	—
1,1,1-Trichloroethane	5 U	5 U	5 U	—
Toluene	5 U	2 J	5 U	—

U - Compound was analyzed for but not detected. The value shown is the contractual sample detection limit.

J - *Indicates an estimated concentration where the value reported is less than the contractual sample detection limit, but greater than the instrument detection limit.*

Table 5-2b. Summary of Radionuclide Analysis from Tank Farm Wells and Well 55-06 (April 1991)

(All values in pCi/l)

Well ID (Sample Date)	TF-2 (4/5/91)	TF-3 (4/5/91)	TF-4 (East) (4/10/91)	Well 55-06 (4/10/91)
Americium-241	25.3± 6.3	0.1 U	0.1U	1 U
Antimony-125	10 U	10 U	10 U	---
Cerium-144	18 U	18 U	18 U	---
Cobalt-59	15 U	15 U	15 U	---
Cobalt-60	9 U	19 U	9 U	10 U
Cesium-134	21.8±11.5U	5.61 ±2.4	10 U	---
Cesium-137	49.8±19.8	1048 ±38	5 U	309±25
Iodine-129	5 U	5 U	5 U	5 U
Neptunium-237	10±5	215± 10	5 U	---
Plutonium-238	0.6 U	0.6 U	0.6 U	---
Plutonium-239/240	0.6 U	0.6 U	0.6 U	---
Ruthenium-103	15 U	15 U	15 U	---
Ruthenium-106	21 U	21 U	21 U	---
Uranium-234*	9+2.1	3.1 ±1.2	4.6±1.6	---
Uranium-235	0.6 U	0.6 U	0.6 U	---
		1.8 ±0.9U	3.7 ±1.4	---
		1059 ±654	500 U	12394+788
Strontium-90	64.6 ±4.6	5.8± 2	374 ±9	37143±86
Gross Alpha (calc.)	52	219.9	8.3	1 U

U - Compound was analyzed for but not detected. The value shown is the contractual sample detection limit.
* - U-234 is a daughter of U-238 and should be in equilibrium. The activity of U-234 should exactly equal that of U-238

Table 5-3. Compounds Detected in the Perched Ground Water Near the Tank Farm During the First, Second and Third Quarterly Sampling in 1992

	TF-2			TF-3			TF-4			55-06		
	Feb 1992	April/May 1992	Sept 1992	Feb 1992	April/May 1992	Sept 1992	Feb 1992	April/May 1992	Sept 1992	Feb 1992	April/May 1992	Sept 1992
RCRA Groundwater Contamination Parameters												
pH	7.47	7.15	DNA	7.64	7.50	DNA	7.50	NS	DNA	7.77	7.79	DNA
Sc (μmho/cm)	400	410	DNA	950	950	DNA	1100	NS	DNA	581	560	DNA
TOX (μg/L)	10.0UJ	16.5U	DNA	61.9	24.5U	DNA	12.4	NS	DNA	41.0	10U	26.4
TOC (mg/L)	1.0U	1.0U	DNA	1.0U	1.0U	DNA	0.9	NS	DNA	1.0U	4.29J	3.25
RCRA Drinking Water Parameters												
Barium (μg/L)	103B	106B	DNA	112B	113B	DNA	330	NS	DNA	162B	152B	187B
Chromium (μg/L)	10.0U	10.0U	DNA	10.0U	10.0U	DNA	10.0U	NS	DNA	23.3	10.0U	6U
Lead (μg/L)	2.0UJ	2.0UJ	DNA	2.0UJ	2.0UJ	DNA	2.0UJ	NS	DNA	2.0U	65.1	2B
Mercury (μg/L)	0.2U	0.2U	DNA	0.2U	0.2U	DNA	0.2U	NS	DNA	0.2U	0.2U	1.1
Fluoride (mg/L)	0.2	0.2	DNA	0.2	0.2	DNA	0.1	NS	DNA	0.2	0.4	0.08
Nitrate (mg/L)	1.1	1.53	DNA	1.6	1.79	DNA	9.3	NS	DNA	7.6	7.17	9.36
RCRA Groundwater Quality Parameters												
Iron (μg/L)	29.7U	15.8B	DNA	25.9U	14.1B	DNA	80.9	NS	DNA	22.1B	16.2B	82U
Sodium (μg/L)	15,700	18,700	DNA	71,400	69,600	DNA	36,100	NS	DNA	40,300	35,700	37,800
Chloride (mg/L)	16	18	DNA	170	270	DNA	145	NS	DNA	39.4	38	48.9
Sulfate (mg/L)	30	32	DNA	56	57	DNA	75	NS	DNA	54.2	44	46.3
Miscellaneous Parameters												
Calcium (μg/L)	54,000	55,300	DNA	93,200	94,800	DNA	154,000	NS	DNA	57,100	62,700	24,600
Magnesium (μg/L)	13,600	13,900	DNA	23,000	23,800	DNA	35,700	NS	DNA	15,900	16,300	19,800
Alkalinity (mg/L)	160	160	DNA	170	170	DNA	330	NS	DNA	195	180	178
Carbonate (mg/L)	0.2	0.2	DNA	1.0	0.8	DNA	1.1	NS	DNA	1.0U	0.4	DNA

Table 5-3. Compounds Detected in the Perched Ground Water Near the Tank Farm During the First, Second and Third Quarterly Sampling in 1992

	TF-2			TF-3			TF-4			55-06		
	Feb 1992	April/May 1992	Sept 1992	Feb 1992	April/May 1992	Sept 1992	Feb 1992	April/May 1992	Sept 1992	Feb 1992	April/May 1992	Sept 1992
Bicarbonate (mg/L)	160	160	DNA	169	170	DNA	329	NS	DNA	195	179.6	DNA
Radionuclides												
Gross alpha (pCi/L)	4.0U	4.0UJ	4.9±2.2	9.76±5.81	5.56±3.75J	2.7±6	8.01±5.69	NS	DNA	4.66±3.32	4.7UJ	ND
Gross beta (pCi/L)	198±21	251±26J	870±10	14.7±3.8	10.8±4J	16±5	850± 87	NS	DNA	1.18E5± 1.2E4	1.28E5± 1.3E4J	ND
Sr-90	96.3±10	116±12J	380±5	5U	5UJ	8.9±1.3	468±47	NS	DNA	47,400± 4800	63,000± 6300J	71,600±80
Tritium	500U	1,890±250 J	ND	500U	234±119J	ND	1170±190	NS	DNA	500U	536±12J	ND

NS = Not Sampled
* = Values are totals and not metals in solution

5.2.1.1 Chemical Results From these three rounds of samples, only lead was detected in a single sample at a concentration exceeding a federal MCL. It was detected at 0.065 mg/l in Well 55-06 during the April/May 1992 sampling round. The federal MCL for lead is 0.015 mg/l. The analytical results from the September 1992 samples did not indicate the presence of lead in the sample collected from this well. Some ground water samples were preserved with nitric acid without being filtered to remove suspended sediments. This practice dissolves metals from clays and other suspended particles and may account for the lead found in well 55-06 during April/May 1992. Generally lead has a low solubility in alkaline ground waters and would not be expected at levels approaching the MCL if the ground water was filtered prior to acidification.

No other chemical constituents were detected at concentrations exceeding federal MCLs.

5.2.1.2 Radiochemical Results The only detectable radionuclides, including gross activities, reported during these three sampling events are gross alpha, gross beta, Sr-90, and tritium. Gross alpha was detected in all four wells at activities less than the federal MCL of 15 pCi/l. Tritium was detected in all wells at concentrations less than 1,890±250J pCi/l. The concentrations are significantly below the federal MCL for tritium of 20,000 pCi/l.

Gross beta activities were measured in Well TF-2 ranging from 198±21 to 870±10 pCi/l, in Well TF-3 ranging from 10.8±4J to 16±5 pCi/l, in Well TF-4 at 850±87 pCi/l, and in Well 55-06 ranging from 118,000±12,000 to 128,000±13,000 pCi/l. All of these values exceed the gross beta MCL of 8 pCi/l, determined by using the conversion formula currently promulgated by the EPA to convert the 4 mrem/year MCL to pCi/l.

Sr-90 has been detected in all four wells at concentrations exceeding the federal MCL of 8 pCi/l. The highest concentrations of Sr-90 were measured in the perched ground water from Well 55-06 with lower concentrations detected in Wells TF-4 and TF-2. In addition, Sr-90 was detected at 8.9±1.3 pCi/l in a single sample from Well TF-3. The results from this, and the previous Sr-90 analyses, are provided in Figure 5-3.

Sr-90 concentrations in Well TF-2 have increased slightly to 380±5 pCi/l since the initial monitoring performed in April 1991. In Well 55-06 however, the Sr-90 concentrations have increased by 18,165 pCi/l to a September 1992 concentration of 71,600±80 pCi/l since the initial monitoring performed in July 1990. The reason(s) for the increase in Sr-90 concentrations are unknown, and may be the result of either decreased dilution from clean water recharging the perched water body or an increase in the leaching of contaminants in the soil. Since the hydrogeology of the perched water has not been evaluated rigorously, the cause for the increase in Sr-90 concentrations in the perched water beneath the tank farm cannot be determined unequivocally.

5.2.2 Lysimeter Water Quality

Lysimeters TF-1L, 3L, and 5L Shallow were functional during the third quarter sampling event. Lysimeters TF-2L and TF-5L Deep appeared to be broken and were not sampled. The three lysimeters which were sampled yielded only small amounts of water and could not be analyzed for all of the targeted analytes. The water recovered was used to determine gamma isotopes and Sr-90 (Table 5-4). Sr-90

Figure 5-3. Sr-90 Concentrations in the Perched Water Wells Near the Tank Farm

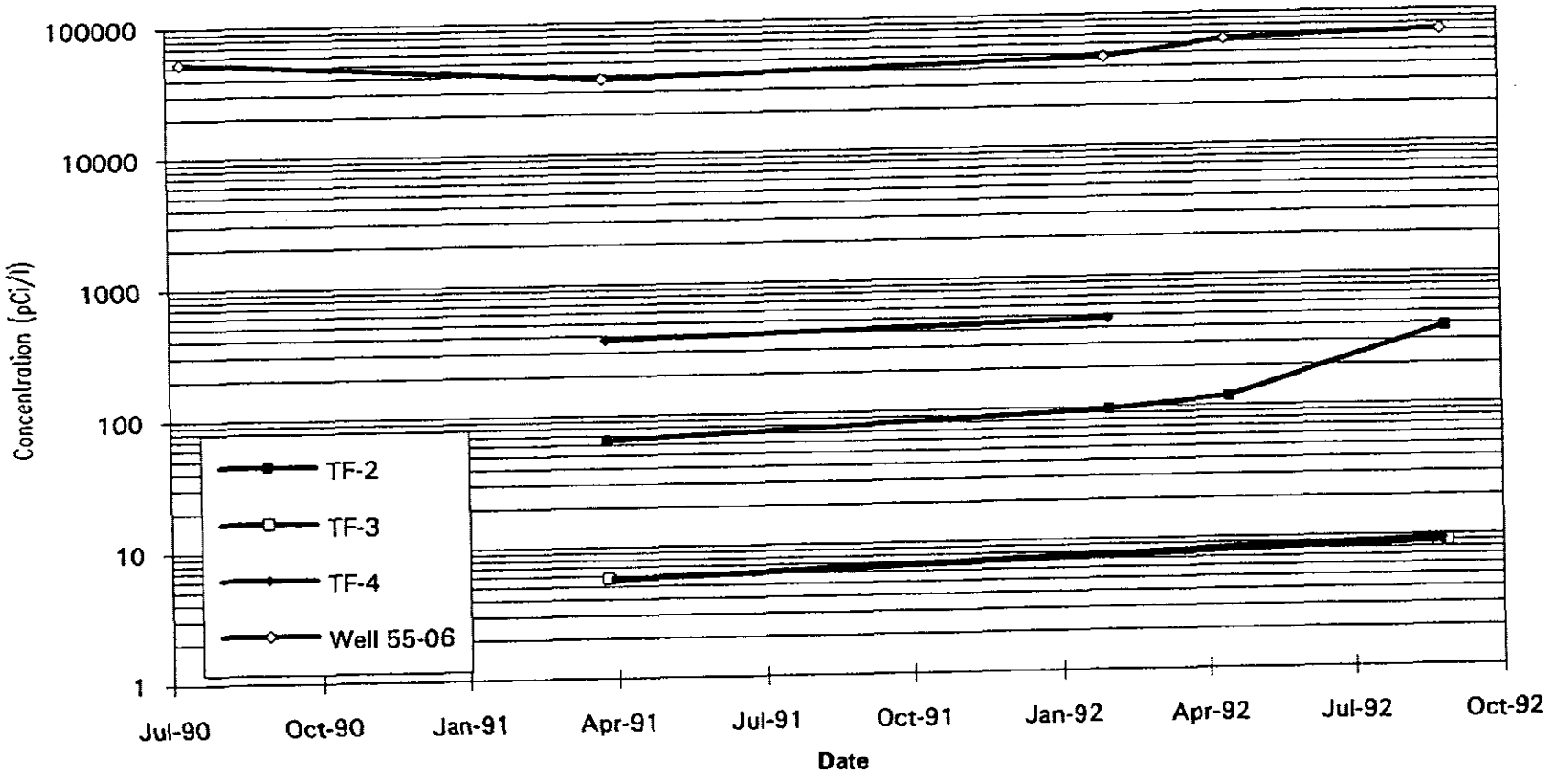


TABLE 5-4
Results from the Lysimeter Sampling during the
Third Quarter in 1992

	TF-1 Lysimeter	TF-3 Lysimeter	TF-5 Shallow Lysimeter
(pCi/L)			
Antimony-125	ND	ND	ND
Cesium-137	ND	ND	ND
Cobalt-60	ND	ND	ND
Iodine-129	NA	NA	NA
Strontium-90	76 $\pm$ 3.0	7.3 $\pm$ 2.3	130 $\pm$ 10
Tritium	NA	NA	NA

NA - Not Analyzed

U - Analyte was analyzed for but was not detected at the concentration reported.

J - Concentration reported is an estimated value.

was the only targeted analyte detected in the lysimeters. Samples were not filtered prior to preservation with nitric acid and the determined values for Sr-90 (76±3, 7.3±2.3, and 130±10 pCi/l for lysimeters TF-1L, TF-3L, and TF-5L Shallow respectively) therefore are total values representing the maximum amount of Sr-90 which could be present in the vadose zone groundwater at these sites. Two of these values are above the Sr-90 MCL of 8pCi/L, but clearly the levels of Sr-90 intercepted by the lysimeters are insufficient to account for the contamination found in well 55-06. The bulk of the Sr-90 contamination must be moving downward at some other site.

5.3 Conclusions

Site CPP-83 is defined to encompass the contaminated ground water within Well 55-06. The water quality from the other tank farm wells may not meet MCL standards either, however, even though contamination levels are several orders of magnitude less than those found in Well 55-06. Low-level Sr-90 contamination of the perched water is not limited to the 55-06 area. At this time, it is uncertain whether the wells monitoring perched water are completed in a single, or multiple, water bodies; whether the source of water is from one, or several recharge points in the raw, treated, potable, or firewater piping; and whether the contamination is from a single "common" source or from multiple sources. A better definition of the geometry of the perched ground water body is needed to better characterize contamination at this site and to evaluate the magnitude of the threat to the Snake River Plain Aquifer from this contamination.

The only complete exposure pathway for this site is by ingestion of groundwater from the Snake River Plain Aquifer. The risk to a future residential receptor via this pathway cannot be calculated because the contaminant source volume and site-specific physical parameters that control contamination migration (i.e., permeability, infiltration rates, and perching layer thicknesses) have not been determined with sufficient certainty. Based on preliminary information, including a Sr-90 concentration in the perched ground water of 71,600±80 pCi/l, it is likely that an unacceptable risk would be calculated for a future residential receptor via ground water ingestion from the Snake River Plain Aquifer using the Track 2 methodology.